2 min

STDN NO. 401.1/ERTS

STATION READINESS TEST
FOR THE
EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS) MISSON

(NASA-TM-X-68582) STATION READINESS TEST FOR THE EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS) MISSION (NASA) ~~359~~ 331 p HC $21.00 CSCL 22D

N74-18890

Unclas

G3/11 31677

MARCH 1972

GSFC

GODDARD SPACE FLIGHT CENTER

GREENBELT, MARYLAND

I

STDN No. 401.1/ERTS

STATION READINESS TEST

FOR THE

EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS)

MISSION

March 1972

Approved by Galicinao
I. Y. Galicinao, Head
Operations Test Section

GODDARD SPACE FLIGHT CENTER

Greenbelt, Maryland

LETTER TO M&O ERTS

The purpose of this SRT is to establish testing procedures which will verify that ERTS supporting stations can effectively support the ERTS mission. This SRT is applicable to all supporting stations for the ERTS-A and ERTS-B missions.

The SRT has been organized to conveniently provide three different levels of testing that will be required throughout the life of the mission for the prime and USB back-up stations. The three testing levels are the prelaunch, prephase, and preorbit levels.

PRELAUNCH

The prelaunch testing level is the most detailed and will be used initially to confirm the operational capability of the sites. Particular emphasis is directed towards the newly installed ERTS modifications and ERTS unique equipments. The results of these detailed tests will be recorded in the SRT document for future reference. Additionally, these tests could be performed upon restoring equipment to operational status from an extended corrective maintenance period. Test results should be recorded and compared with the original results. Testing procedures for the prelaunch testing level are contained throughout the entire SRT in sections 1, 2, 3, and 4. Stations should refer to their respective SRT checklist for the particular parts of these sections which are applicable to them.

PREPHASE

A second, less time consuming level of testing, the prephase level, will be used to confirm station readiness at the beginning of each respective support period where a support period is defined as a consecutive series of passes. The Alaska prime ERTS station will have one support period per day consisting of approximately 10 consecutive passes. All other stations will have a maximum of two support periods per day consisting of one or more consecutive passes each.

The sections of the SRT which are applicable to prephase testing are limited to sections 2, 3, and 4. Once again the stations are referred to their respective SRT checklist to determine which particular parts of these sections are applicable.

PREORBIT

The third and more abbreviated level of testing, preorbit testing, will be performed prior to each pass, except the first pass of a support period following the completion of prephase testing. Preorbit testing will be largely limited to section 4 of the SRT.

The three testing types have been adapted in this SRT to efficiently satisfy the three different needs for testing. Therefore, each of the testing levels were optimized with respect to the detail required and the time allowed for testing.

The following chart depicts the intention of this SRT:

SRT Sections	Prelaunch	Prephase	Prepass
1. System Interface Tests	Required	Not required	Not required
2. Hardware Tests	Required	Required	Partial
3. On-site Data Flow Tests	Required	Required	Not required
4. Prepass Activities	Required	Required	Required

The guidelines for performing the SRT may be altered as directed by the NOCC/OCC to meet real-time requirements.

Your comments or recommendations to this SRT are welcomed and should be directed to this office.

J. Y. Galiciano, Head
Operations Test Section

DCN CONTROL SHEET

Use this control sheet to record the DCN changes to this document.

DCN No.	DTG	Mon/Yr	Initials	

ERTS Support Chart

	C-Band	*Emergency Backup	Launch Vehicle	Backup VHF	Backup USB	Prime ERTS
ACN		X			X	
AVE		X				
BDA	X	X			X	
BUR		X		X		
CRO	X	X			X	
CYI		X			X	
ETC ERTS						X
ETC USB		X				
ETC VHF		X				
FT MYRS		X				
GDS ERTS						X
GDS USB		X			X	
GWM		X			X	
HAW	X	X	X		X	
HSK		X			X	
MAD		X	X		X	
MIL		X			X	
ORR		X				
QUI		X				
ROS		X		X		
SAN		X		X		
TAN	X	X	X	X		
TEX		X			X	
ULA		X	X	X		X
WNKFLD		X				

* Emergency supporting stations will refer to their restrictive USB or VHF B/U SRT check list.

SRT Checklist for Alaska-ERTS

Test Title	Para	Prelaunch	Pre-phase	Pre-orbit
SECTION 1 - SYSTEM INTERFACE TESTS (SIT)				
S-band PM Bit Error Rate Test	1.1	X		
MSS FM Downlink Test	1.2	X		
RBV FM Downlink Test	1.3	X		
SECTION 2 - HARDWARE TESTS				
Intercom Confidence Tests	2.1	X	X	X
Stripchart, Event, and Magnetic Tape Rcdrs	2.2	X	X	X
Topocentric Drive	2.3.2.1	X	X	
S-band Snap-on	2.3.2.2	X	X	
Minitrack Interferometer Test	2.3.3	X	X	X
Alaska PM AGC Calibration Test	2.4.2	X	X	
Alaska FM S-band AGC Calibration Test	2.4.3	X	X	
VHF AGC Calibration Test	2.4.4	X	X	
CAGE Uplink Data Test	2.5.2	X	X	
OGO Uplink Data Test	2.5.3	X		
PM Downlink Data Test	2.6.1	X	X	
VHF Downlink Data Test	2.6.2	X		
MSS Downlink Data Test	2.7	X	X	

SRT Checklist for Alaska-ERTS (cont)

Test Title	Para	Prelaunch	Pre-phase	Pre-orbit
RBV Downlink Data Test	2.8	X	X	
Launch Vehicle Downlink Test	2.9.2	X		
COST Test	2.10.2	X		
Acquisition Bus Slaving	2.11	X	X	
SECTION 3 - ON-SITE STATION FLOW TEST				
ERTS and B/U USB on-site Data Flow Test	3.1.2	X	X	
Dump Data Flow Test	3.2	X	X	
SECTION 4 - PRE-PASS ACTIVITIES				
DCS Loop Test	4.1			X
MSS Loop Test	4.2			X
RBV Loop Test	4.3			X
CMD and TLM Interface Test	4.4	X	X	X
Tracking System Autotrack Test	4.5			X

SRT Checklist for Goldstone-ERTS

Test Title	Para	Prelaunch	Pre-phase	Pre-orbit
SECTION 1 - SYSTEM INTERFACE TESTS (SIT)				
S-band PM Bit Error Rate Test	1.1	X		
MSS FM S-Band Downlink Test	1.2	X		
RBV FM S-Band Downlink Test	1.3	X		
SECTION 2 - HARDWARE TESTS				
Intercom Confidence Tests	2.1	X	X	X
Recorders	2.2	X	X	X
USB Metric Data Test	2.3.1	X	X	
USB AGC Calibration Test	2.4.1	X	X	
USB Uplink Data Test	2.5.1	X	X	
S-band PM Downlink Data Test	2.6.1	X	X	
MSS FM Downlink Data Test	2.7	X	X	
RBV FM Downlink Data Test	2.8	X	X	
COST Test	2.10.2	X		
Acquisition Bus Slaving	2.11	X	X	
SECTION 3 - ON-STATION DATA FLOW TESTS				
ERTS and B/U USB On-Site Data Flow Test	3.1.2	X	X	
DCS Data Flow Test	3.3	X	X	

SRT Checklist for Goldstone-ERTS (cont)				
Test Title	Para	Prelaunch	Pre-phase	Pre-orbit
SECTION 4 - PRE-PASS ACTIVITIES				
DCS Loop Test	4.1			X
MSS Loop Test	4.2			X
RBV Loop Test	4.3			X
CMD and TLM Interface Test	4.4	X	X	X
Tracking System Autotrack Test	4.5			X

SRT Checklist for Engineering Training Center-ERTS				
Test Title	Para	Prelaunch	Pre-phase	Pre-orbit
SECTION 1 - SYSTEM INTERFACE TEST (SIT)				
S-band PM Bit Error Rate Test	1.1	X		
MSS FM S-Band Downlink Test	1.2	X		
RBV FM S-Band Downlink Test	1.3	X		
SECTION 2 - HARDWARE TESTS				
Intercom Confidence Tests	2.1	X	X	X
Recorders	2.2	X	X	X
USB Metric Data Test	2.3.1	X	X	
USB AGC Calibration Test	2.4.1	X	X	
USB Uplink Data Test	2.5.1	X	X	
CAGE VHF Uplink Data Test	2.5.2	X	X	
S-band PM Downlink Data Test	2.6.1	X	X	
MSS FM Downlink Data Test	2.7	X	X	
RBV FM Downlink Data Test	2.8	X	X	
COST ERTS (CERTS)	2.10.1	X		
Acquisition Bus Slaving	2.11	X	X	
SECTION 3 - ON-STATION DATA FLOW TESTS				
ETC Data Flow Test	3.1.1	X	X	
DCS Data Flow Test	3.3	X	X	

SRT Checklist for Engineering Training Center-ERTS (cont)				
Test Title	**Para**	**Prelaunch**	**Pre-phase**	**Pre-orbit**
SECTION 4 - PREPASS ACTIVITIES				
DCS Loop Test	4.1			X
MSS Loop Test	4.2			X
RBV Loop Test	4.3			X
CMD and TLM Interface Test	4.4	X	X	X
Tracking System Autotrack Test	4.5			X

SRT Checklist for VHF B/U Stations			
SECTION 2-HARDWARE TESTS	Para	Prelaunch	Pre-orbit *
Intercom Confidence Test	2.1	X	X
Recorders	2.2	X	X
Metric Data Test	2.3.2	X	
Minitrack	2.3.3	X	X
VHF AGC Calibration Test	2.4.4	X	X
OGO Uplink Data Test	2.5.3	X	X
VHF PM Downlink Data Test	2.6.2	X	X
Launch Vehicle Downlink Test (TAN and ULA)	2.9.2	X	
Acquisition Bus Slaving	2.11	X	X
CAPRI Radar (TAN only)	2.12.3	X	
SECTION 3 - ON-STATION DATA FLOW TESTS			
VHF Data Flow Test	3.4	X	X
SECTION 4 - PREPASS ACTIVITIES			
Tracking System Autotrack Test	4.5		X

* Actual degree of pre-orbit testing will be limited to the station's available time.

SRT Checklist for USB B/U Stations				
Test Title	**Para**	**Prelaunch**	**Pre-phase**	**Pre-orbit**
SECTION 1 - SYSTEM INTERFACE TESTS (SIT)				
S-band PM Bit Error Rate Test	1.1	X		
SECTION 2 - HARDWARE TESTS				
Intercom Confidence Tests	2.1	X	X	X
Recorders	2.2	X	X	X
USB Metric Data Test	2.3.1	X	X	
USB PM AGC Calibration Test	2.4.1	X	X	
USB Uplink Data Test	2.5.1	X	X	
S-band PM Downlink Test	2.6.1	X	X	
Launch Vehicle Downlink Test (HAW-MAD)	2.9.1	X		
COST Test	2.10.2	X		
Acquisition Bus Slaving	2.11	X	X	
FPQ-6 Radar	2.12.1	X	X	
FPS-16 Radar	2.12.2	X	X	
SECTION 3 - ON-STATION DATA FLOW TESTS				
ERTS and B/U USB On Site Data Flow Test	3.1.2	X	X	
SECTION 4 - PRE-PASS ACTIVITIES				
CMD and TLM Interface Test	4.4	X	X	X
Tracking System Autotrack Test	4.5			X

CONTENTS

Section	Page
1. SYSTEMS INTERFACE TESTS	
1.1 S-band PM Bit Error	1-1
1.1.1 General	1-2
1.1.2 Test Procedures	1-2
1.2 MSS FM Downlink Data Test	1-19
1.2.1 General	1-20
1.2.2 Test Procedures	1-20
1.3 RBV FM Downlink Test	1-39
1.3.1 General	1-40
1.3.2 Test Procedures	1-40
2. HARDWARE TESTS	
2.1 Intercommunications System Confidence Test	2-1
2.2 Stripchart Event and Magnetic Tape Recorders	2-3
2.2.1 Stripchart Recorders	2-3
2.2.2 Event Recorders	2-3
2.2.3 Magnetic Tape Recorders	2-3
2.2.4 Reloading and Annotating	2-4
2.2.5 TR-70 Video Tape Recording Setup	2-4
2.3 Metric Data Tests	2-7
2.3.1 Unified S-band Metric Data Test	2-9
2.3.2 Alaska (ULA) VHF Metric Data Tests	2-31
2.3.3 Minitrack Interferometer	2-37
2.4 Automatic Gain Control Calibration	2-39
2.4.1 Unified S-band AGC Calibration Tests	2-41
2.4.2 Alaska PM AGC Calibration Test (2287.5 MHz S-band)	2-47
2.4.3 Alaska FM S-band AGC Calibration Test	2-49
2.4.4 VHF PM AGC Calibration Test (137.86 MHz)	2-51
2.5 Uplink Data Tests	2-53
2.5.1 Unified S-band Uplink Data Tests	2-55
2.5.2 CAGE VHF Uplink Data Test	2-61
2.5.3 OGO Encoder VHF Uplink Test	2-67
2.6 PM Downlink Data Tests	2-69
2.6.1 S-band PM Downlink Data Test	2-71
2.6.2 VHF PM Downlink Data Test	2-85

Section	Page
2.7 MSS FM Downlink Test	2-91
2.7.1 General	2-91
2.7.2 Test Procedures	2-91
2.8 RBV FM Downlink Test	2-103
2.8.1 General	2-103
2.8.2 Test Procedures	2-103
2.9 Launch Vehicle Tests	2-113
2.9.1 Launch Vehicle, Second Stage Data Flow Test (MAD, HAW and ULA)	2-115
2.9.2 Tananarive Launch Vehicle Support	2-127
2.10 Remote Site Data Processor and Peripheral Equipment	2-135
2.10.1 COST ERTS (CERTS) Test	2-139
2.10.2 COST Test	2-145
2.11 Acquisition Bus Slaving	2-149
2.11.1 Status Indications (USB Stations)	2-149
2.11.2 Slaving Test	2-149
2.11.3 Stations Without Normal Acq Bus	2-150
2.12 Tracking Radar Systems	2-155
2.12.1 FPQ-6 Radar	2-157
2.12.2 FPS-16 Radar	2-165
2.12.3 CAPRI Radar	2-173
3. DATA FLOW TESTS	
3.1 Real-time Data Flow Tests	3-1
3.1.1 ETC Dump and Real-time Data Flow Test	3-3
3.1.2 ULA, GDS, and Backup USB Station Data Flow Test	3-21
3.2 Dump Data Flow Test (Alaska Only)	3-43
3.2.1 S-band Dump Data (2287.5 MHz Link)	3-43
3.2.2 VHF Dump Data Test (137.86 MHz)	3-45

Section	Page
3.3 DCS Data Flow Test	3-47
3.3.1 Test Applicability	3-47
3.3.2 Test Procedures	3-47
3.4 VHF Station Data Flow Test	3-55
3.4.1 Real-time PCM Data	3-55
3.4.2 Dump PCM Data	3-55
4. PREPASS ACTIVITIES	
4.1 DCS Loop Test	4-1
4.2 MSS Pre-pass Loop Test	4-3
4.3 RBV Pre-pass Loop Test	4-9
4.4 CMD and TLM Interface Test	4-12
4.5 Tracking System Autotrack Test	4-14
APPENDIX A FM Modulation Sensitivity Test	A-1
APPENDIX B Test Criteria Calculations	B-1
APPENDIX C PM Modulation Index Setup	C-1
APPENDIX D PCM Switch Settings and Test Configuration	D-1

ILLUSTRATIONS

Figure	Page
1-1 S-band PM Downlink Test Configuration (GDS)	1-9
1-2 S-band PM Downlink Configuration (ETC/OCC)	1-10
1-3 S-band PM Downlink Configuration (USB Backup)	1-11
1-4 S-band Downlink Test Configuration (Alaska)	1-12
1-5 1.0-kb/sec Data Graph	1-15
1-6 ERTS 1 kb/sec BER Test Criteria	1-16
1-7 24-kb/sec Data Graph	1-17
1-8 ERTS 24-kb/sec BER Test Criteria	1-18
1-9 MSS Test Criteria (ETC/GDS)	1-21
1-10 MSS Test Criteria (ULA)	1-22
1-11 MSS Performance Data	1-23
1-12 MSS Test Configuration (GDS)	1-34
1-13 MSS Test Configuration (ETC/OCC)	1-35

ILLUSTRATIONS (cont)

Figure		Page
1-14	MSS Test Configuration (ULA)	1-36
1-15	RBV Downlink Test Configuration (EGD)	1-48
1-16	RBV Test Configuration (ETC/OCC)	1-49
1-17	RBV Downlink Test Configuration (ULA)	1-50
1-18	RBV Test Criteria (ETC and GDS)	1-54
1-19	RBV Test Criteria (ULA)	1-55
1-20	VPASS Timing	1-56
2-1	Preliminary Equipment Setup	2-10
2-2	Sample Acquisition Message for SRT	2-11
2-3	Test Setup for AGC/Threshold	2-41
2-4	Waveform for UDB Signal	2-56
2-5	PM Modulation Index (Radians) (Sinewave Modulation)	2-58
2-6	Square Wave PM Modulation Index (Radians)	2-59
2-7	VHF Modulation Envelope	2-65
2-8	CAGE Command Modulation Phasing	2-66
2-9	S-band PM Downlink Test Configuration (Goldstone ERTS)	2-76
2-10	S-band PM Downlink Test Configuration (ETC/OCC)	2-77
2-11	S-band PM Downlink Test Configuration (USB Backup)	2-78
2-12	S-band PM Downlink Test Configuration (ULA ERTS)	2-79
2-13	ERTS 1kb/sec BER Test Criteria	2-82
2-14	ERTS 24 kb/sec BER Test Criteria	2-83
2-15	VHF Bit Error Rate Test (Using GD RCVR)	2-86
2-16	VHF Bit Error Rate Test (Using MFRT RCVR)	2-87
2-17	Bit Error Rate as a Function of Signal Level	2-89
2-18	MSS Test Criteria (ENT and EGD)	2-92
2-19	MSS Test Criteria (ULA)	2-93
2-20	MSS Test Configuration (EGD)	2-99
2-21	MSS Test Configuration (ETC/OCC)	2-100
2-22	MSS Test Configuration (ULA)	2-101
2-23	RBV Downlink Test Configuration (GDS)	2-107
2-24	MSS/RBV Test Configuration (ETC/OCC)	2-108
2-25	RBV Downlink Test Configuration (ULA)	2-109

ILLUSTRATIONS (cont)

Figure | Page

2-25A Second Stage Telemetry Data Flow, Typical Equipment Configuration (MAD, HAW and ALASKA) 2-125

2-26 SCO Calibration Test 2-128

2-27 Second Stage Telemetry Data Flow Typical Equipment Configuration (TAN) 2-134

2-28 Typical TTY Subtest Configuration 2-136

2-29 DTU Subtest Equipment Configuration 2-137

2-30 COST Tests Equipment Configuration 2-137

2-31 ERTS CAM 2-143

2-32 Azimuth-Elevation to X-Y Conversion Chart for ERTS Prime and 85-foot USB Station 2-152

2-33 AZ-EL to X-Y and X-Y to AZ-EL Conversion Chart 2-153

2-34 Timing Waveform 2-163

3-1 ETC Typical Configuration 3-4

3-2 CMD Parameter Listing Printout 3-10

3-3 Critical RTC Review Printout 3-11

3-4 Computer Fault and Recovery Printout 3-12

3-5 Select Mode 1 Printout 3-12

3-6 Uplink Real-time Command Printout 3-13

3-7 Abort Real-time Printout 3-14

3-8 Echo Check Override On Printout 3-15

3-9 Uplink Real-time Command with Override On Printout 3-15

3-10 Echo Check Override Off Printout 3-16

3-11 Uplink Command with CAGE Disabled and Override Off Printout 3-16

3-12 Uplink Command with CAGE On Printout 3-17

3-13 Mode 2 Selection Printout (OCC) 3-17

3-14 Parameter Listing Request Printout 3-18

3-15 Select Mode 1 Printout 3-18

3-16 Uplink Summary Initiation Printout 3-19

3-17 End-of-file Initiation Printout 3-20

3-18 OCC Command History Initiation Printout 3-20

3-19 EGD Backup USB Station Typical Configuration 3-22

3-19A ULA Typical Test Configuration 3-23

ILLUSTRATIONS (cont)

Figure		Page
3-20	Parameter Listing Printout	3-29
3-21	Critical RTC Review Printout	3-30
3-22	Computer Fault and Recovery Printout	3-31
3-23	Select Mode 1 Printout	3-31
3-24	Dump Telemetry Playback Printout	3-32
3-25	Uplink Real-time Command Printout	3-33
3-26	Abort Real-time Command Printout	3-34
3-27	Echo Check On Printout	3-34
3-28	Uplink Command with CAGE/UDB Disabled and Override On Printout	3-35
3-29	Echo Check Off Printout	3-35
3-30	Uplink Command with CAGE/UDB Unit On Printout	3-36
3-32	Parameter Listing Printout	3-37
3-33	Simulated HSD Inputs from OCC and Real-time TLM Flow Printout	3-38
3-34	Select Mode 1 Printout	3-41
3-35	Uplink Summary Initiation Printout	3-41
3-36	(Deleted)	
3-37	End-of-file Initiation Printout	3-52
3-38	Local Command History Initiation Printout	3-42
3-39	OCC Command History Initiation Printout	3-42
3-40	S-band On-site Dump Data Flow Test Configuration (ULA)	3-44
3-41	VHF Dump Data Test Configuration (ULA)	3-46
3-42	DCS Data Flow Test Configuration (GDS and ULA)	3-50
3-43	DCS Data Flow Test Configuration (ETC)	3-51
3-44	Formatter Buffer Output Message Format	3-53
3-45	Real-time PCM Test Configuration	3-56
3-46	Dump Data Flow Test Configuration	3-57
4-1	Prepass Loop Test Configuration (Alaska ERTS Station)	4-6
4-2	Prepass Loop Test Configuration (Goldstone ERTS Station)	4-7
4-3	Prepass Loop Test Configuration (ETC/OCC ERTS Station)	4-8

TABLES

Table	Page
1-1 PM Downlink Test Parameters	1-13
1-2 DCS Equipment Test Settings	1-14
1-3 Equipment Setup	1-37
1-4 Equipment Test Parameters	1-51
1-5 Test Criteria	1-53
2-1 Transmitter Operating Parameters	2-62
2-2 PM Downlink Test Parameters	2-80
2-3 DCS Equipment Test Settings	2-81
2-4 Equipment Setup	2-102
2-5 Equipment Test Parameters	2-110
2-6 Test Criteria	2-112
2-7 Carrier Deviations	2-117
2-8 Channels 1 and 3 Deviations	2-130
2-9 Carrier Deviations	2-132
2-10 COST/CERTS-ISA CAM Combination	2-142
3-1 DCS Equipment Test Settings	3-52
4-1 DCS Preliminary Setup	4-2

1.1 S-BAND PM BIT ERROR RATE TEST

OBJECTIVE

The objective of this test is to determine the integrated systems performance from the parametric amplifier input through postdetection of the data streams.

TEST DESCRIPTION

The test objective is accomplished by modulating the S-band PM test transmitter with a simulated mission modulation/data scheme. The output of the test transmitter is injected into the parametric amplifier. Postdetection bit error rates are measured to verify the integrated systems performance at specific parametric amplifier input levels.

TEST EQUIPMENT REQUIRED

The following test equipment or equivalent is required to perform this test:

a. PCM simulator, MSFPT-2.

b. DCS self-test unit.

c. PSK simulator, Monitor 820.

d. Video amplifier, C-COR 4953B.

e. PM test transmitter.

f. Power meter, HP-431.

g. Spectrum analyzer, HP-8551.

h. Test injection network.

i. Variable attenuator, Narda 784.

j. Error counter, Atec 7A86.

k. Dual-channel oscilloscope, Tektronix 545.

l. DC digital voltmeter, Dymec 2401.

m. PCM simulator programs.

1.1.1 GENERAL

1.1.1.1 The Network Test and Training Facility (NTTF) Earth Resources Technology Satellite (ERTS) station should coordinate these tests with the ERTS Operations Control Center (OCC) since all detection and simulation equipment except the Data Collection System (DCS) are physically located at the ERTS OCC. ERTS OCC ground station personnel will perform the telemetry (TLM) and recorder (RCDR) operator functions on the RT and Dump test sequences and will utilize the HP-1900 pulse system for PCM simulation and error detection vice PCM simulator and bit comparator. The NTTF ERTS station may perform the complete test locally utilizing NTTF equipments (not dedicated to the ERTS mission) for data simulation and detection.

1.1.1.2 The ETC station Test Conductor (TC) is the coordinator for this testing and will require real-time and dump data support from the ERTS OCC.

1.1.1.3 The BERTS program (TESOC Control No. 6-701) should be utilized in the MSFTP-2 simulator for the ERTS real-time and dump mode bit error rate tests. The ERTS SEQ 1043S (TESOC Control No. 4-043) simulator program may be used if the BERTS program is not available.

1.1.2 TEST PROCEDURES

Use the following procedures to perform the S-band PM downlink test:

S-Band PM Downlink Test

Seq	Test	Operator	Instructions
1	RT	TC/USB/TLM*/ RCDR/MFR	Configure the equipment as shown in figure 1-1, 1-2, 1-3, or 1-4, for applicable station.
2	RT	USB/TLM*/ MFR	Set up the S-band and TLM equipment in accordance with tables 1-1 and 1-2.
3	RT	USB/TLM*/MFR	Set up the individual subcarriers to phase modulate the S-band test transmitter as follows: Subcarrier — Mod Index — Carrier Suppression RT 768 kHz — 0.30 rad. — 0.2 dB DT 597 kHz — 0.81 rad. — 1.5 dB DCS 1.024 MHz — 0.99 rad. — 2.3 dB Composite — — 4.0 dB Total Note ETC ERTS station personnel should verify optimum reception of the 597 and 768-kHz subcarrier signals from the ERTS OCC prior to setting the modulation indicies.
4	RT	TLM*	Set up the PCM simulator for 1-kb/sec split-phase data. Set the PCM simulator 1-kb/sec output to PSK the 768-kHz SCO ±90 degrees.
5	RT	USB/MFR	Position the antenna to zenith (quiet sky) and lock the receiver to the S-band test transmitter 2287.5-MHz carrier.
6	RT	USB/MFR	With the 1.024-MHz, 597-kHz, and 768-kHz subcarrier oscillators connected to simultaneously phase modulate the PM test transmitter, set the test transmitter for a suppressed carrier level (AGC reference) of -115 dBm into the parametric amplifier (-113 dBm at Alaska).
7	RT	TLM*	Adjust the delay on the bit comparator until the SEL DATA and DELAYED DATA signals are in phase as displayed on channels A and B of the oscilloscope.

*For ETC testing, the TLM operator is located at the OCC.

S-Band PM Downlink Test (cont).

Seq	Test	Operator	Instructions
8	RT	RCDR *	Verify correct record level of the real-time data at the magnetic tape recorders by recording, reproducing, and monitoring the recorded and reproduced data.
9	RT	TLM*/TC	With the Atec BER counter set up for a 10^6 BER measurement, press the RESET switch and record the error count. Repeat the error count twice and report the average of the three readings to the Test Conductor.
10	RT	USB/MFR	Attenuate the input to the parametric amplifier by 1 dB.
11	RT	USB/TLM*/TC	Repeat steps 9 and 10 until an error count of 10,000 errors in 10^6 is obtained.
12	RT	TC	Record the average BER count versus signal level on graph of figure 1-5. Draw a curve representing best fit of the data points and retain the completed graph for station record. Verify that the data meets the test criteria of figure 1-6.
13	DUMP	TLM *	Set up the PCM simulator to generate a 24-kb/sec split-phase data stream. Set the PCM simulator 24-kb/sec output to PSK the 597-kHz SCO ± 90 degrees.
14	DUMP	USB/MFR	With the 1.024-MHz, 597-kHz, and 768-kHz subcarrier oscillators connected to simultaneously modulate the PM test transmitter, set the test transmitter output for a suppressed carrier level (AGC reference) of -115 dBm into the parametric amplifier (-113 dBm at Alaska).
15	DUMP	TLM*	Adjust the delay on the bit comparator until the SEL DATA and DELAYED DATA signals are in phase as displayed on the oscilloscope.

*For ETC testing, the TLM and RCDR operators are located at the OCC.

S-Band PM Downlink Test (cont).

Seq	Test	Operator	Instructions
16	DUMP	TLM *	With the Atec BER counter set up for a 10^6 BER measurement, press the RESET switch and record the error count.
17	DUMP	RCDR *	Verify correct record level of the dump data at the magnetic tape recorder by recording, reproducing, and monitoring the recorded and reproduced data.
18	DUMP	TLM*/TC	Repeat step 16 twice and report the average of the three readings to the TC.
19	DUMP	USB/MFR	Attenuate the input to the parametric amplifier by 1 dB.
20	DUMP	USB/TLM*/TC/ MFR	Repeat steps 16, 18, and 19 until an error count of 10,000 errors in 10^6 is obtained.
21	DUMP	TC	Record the average BER count versus signal level on the graph of figure 1-7. Draw a curve representing best fit of the data points and retain the graph for station records. Verify that the data meets the test criteria of figure 1-8.
22	DUMP	USB/TLM*/TC/ MFR	Repeat sequences 1 through 21, as applicable, to validate all receivers and decoms.
			Note Sequences 23 through 48 are applicable to prime ERTS stations only.
23	DCS	USB/MFR	With the 1.024-MHz, 597-kHz and 768-kHz subcarrier oscillators connected to simultaneously modulate the PM test transmitter, set the test transmitter output for a suppressed carrier level (AGC reference) of -121 dBm (-119 dBm at Alaska) into the parametric amplifier.

* For ETC testing, the TLM operator is located at the OCC.

S-Band PM Downlink Test (cont)

Seq	Test	Operator	Instructions
24	DCS	DCS/TC	At the STU, press the display CLEAR and MESSAGE COUNTER PBI's. Set the TEST MODE CONTROL RUN/HOLD PBI to RUN. When the STU display (MESSAGE COUNTER) reaches 20,000, set the RUN/HOLD switch to HOLD. Report the MESSAGE COUNTER reading to the TC. Set the MESSAGE COUNTER and GOOD MESSAGE PBI's to display GOOD MESSAGES. Report the GOOD MESSAGE reading to the TC. Set the GOOD MESSAGE and MESSAGE ERROR PBI's to display MESSAGE ERRORS. Report the MESSAGE ERRORS reading to the TC. Set the MESSAGE ERRORS and BAD MESSAGES PBI's to display BAD MESSAGES. Report BAD MESSAGES reading to the TC.
25	DCS	TC	Calculate the missed message rate and message error rate as follows: Missed message rate = $\frac{\text{Message counter - Good messages}}{\text{Message Counter}} \leq 5 \times 10^{-2}$ Message error rate = $\frac{\text{Message Errors}}{\text{Good Messages}} \leq 1 \times 10^{-3}$
26	DCS	DCS	Set the STU TEST MODE CONTROL RUN/HOLD PBI to RUN. Set the NOISE ON/OFF switch to ON and set the C/KT ADJUST to +3.
27	DCS	USB/MFR	Reset the test transmitter output for a suppressed carrier level (AGC reference) of -112 dBm (-110 dBm at Alaska) into the parametric amplifier.
28	DCS	RCDR	Verify correct record level of the following DCS signals at the recorder inputs: a. FM demod IF output. b. FM demod video output. c. Conv decoder clock output. d. Conv decoder data output. e. Serial decimal time code.
29	DCS	DCS	Set the STU TEST MODE CONTROL RUN/HOLD PBI to HOLD. Press DISPLAY CLEAR PBI.

S-Band PM Downlink Test (cont)

Seq	Test	Operator	Instructions
30	DCS	RCDR	Load the magnetic tape recorder with clean tape. Start the tape recorder and periodically announce station time on the voice track using "Days-hours-minutes-seconds-mark" sequence.
31	DCS	DCS	After start of the tape recorders, set the STU TEST MODE CONTROL RUN/HOLD PBI to RUN. Select MESSAGE COUNTER on the STU display.
32	DCS	DCS	When the STU MESSAGE COUNTER display indicates 20,000, set the RUN/HOLD PBI to HOLD.
33	DCS	RCDR	Stop the tape recorder and rewind tape.
34	DCS	DCS/TC	Selectively display the contents of the MESSAGE COUNTER, GOOD MESSAGES, BAD MESSAGES, and MESSAGE ERRORS at the STU display. Report the contents of each counter display to the TC.
35	DCS	TC	Verify missed message rate is less than 5×10^{-2} and message error rate is less than 1×10^{-3}, using method of sequence 25.
36	DCS	DCS/RCDR	Configure the equipment to play back the recorded FM demod IF signal, SDTC, and voice annotation.
37	DCS	DCS	Operate the STU DISPLAY CLEAR PBI. Operate the formatter/buffer MASTER CLEAR PBI and verify CLEAR TO SEND indicator is on.
38	DCS	RCDR/DCS	Start the tape recorder (REPRODUCE mode) and play back the recorded interval. Monitor the voice track during playback and verify that the time code reader display and voice annotation concur.
39	DCS	RCDR/DCS/TC	Stop the tape recorder at the end of the recorded data. Read out the contents of the MESSAGE COUNTER, GOOD MESSAGE counter, and BAD MESSAGE counter. Report the contents of each counter to the TC.
40	DCS	TC	Verify that the sum of good messages and bad messages reported in sequence 39 equals MESSAGE COUNTER reading. Verify missed message rate is less than 5×10^{-2} using

S-Band PM Downlink Test (cont)

Seq	Test	Operator	Instructions
40 (cont)	DCS	TC	MESSAGE COUNTER reading of sequence 34 and GOOD MESSAGES reading of sequence 39.
41	DCS	RCDR/DCS	Rewind the magnetic tape to the beginning of the recorded data. Set up the recorder and DCS equipment to play back the FM demod video into the bit demodulator.
42	DCS	DCS	Operate the STU DISPLAY CLEAR PBI. Operate the formatter/buffer MASTER CLEAR PBI and verify that the CLEAR TO SEND indicator is on.
43	DCS	RCDR/DCS/TC	Start the tape recorder and play back the recorded data. Stop the tape recorder at the end of the recorded data. Read out the contents of the MESSAGE COUNTER, GOOD MESSAGE counter and BAD MESSAGE counter. Report the contents of each counter to the TC.
44	DCS	TC	Verify that the sum of the good messages and bad messages reported in sequence 43 equals MESSAGE COUNTER reading. Verify missed message rate is less than 5×10^{-2} using MESSAGE COUNTER reading of sequence 34 and GOOD MESSAGES reading of sequence 43.
45	DCS	RCDR/DCS	Rewind the magnetic tape to the beginning of the recorded data. Set up the recorder and formatter/buffer for playback of the recorded convolutional decoder data.
46	DCS	DCS	Operate the STU DISPLAY CLEAR PBI. Operate the formatter/buffer MASTER CLEAR PBI and verify that the CLEAR TO SEND indicator is on.
47	DCS	RCDR/DCS/TC	Start the tape recorder and play back the recorded data. Stop the tape recorder at the end of the recorded data. Read out and report the contents of the MESSAGE COUNTER to the TC.
48	DCS	TC	Verify that the MESSAGE COUNTER reading of sequence 47 equals the sum of good messages and bad messages reported in sequence 24.

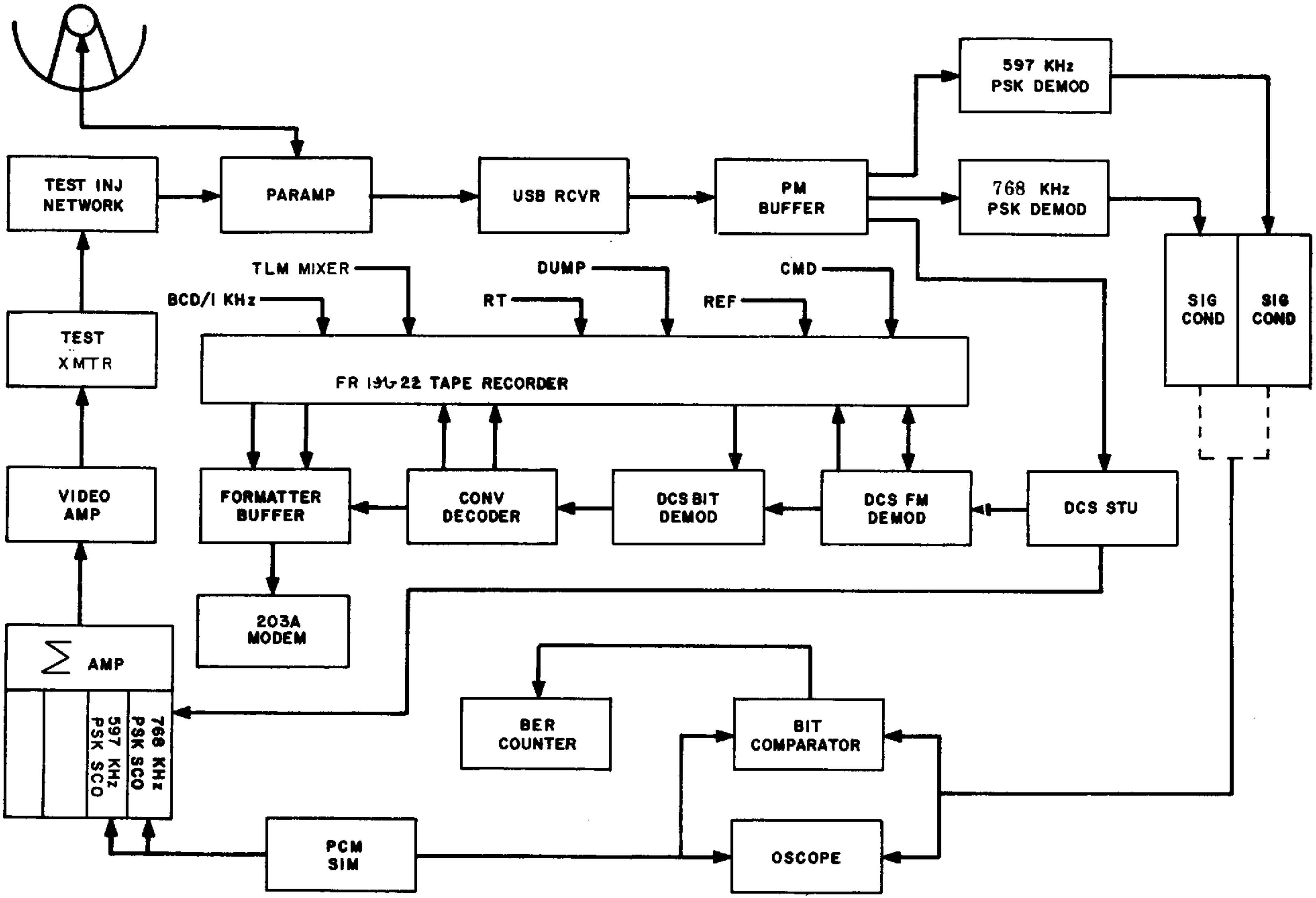


Figure 1-1. S-band PM Downlink Test Configuration (GDS)

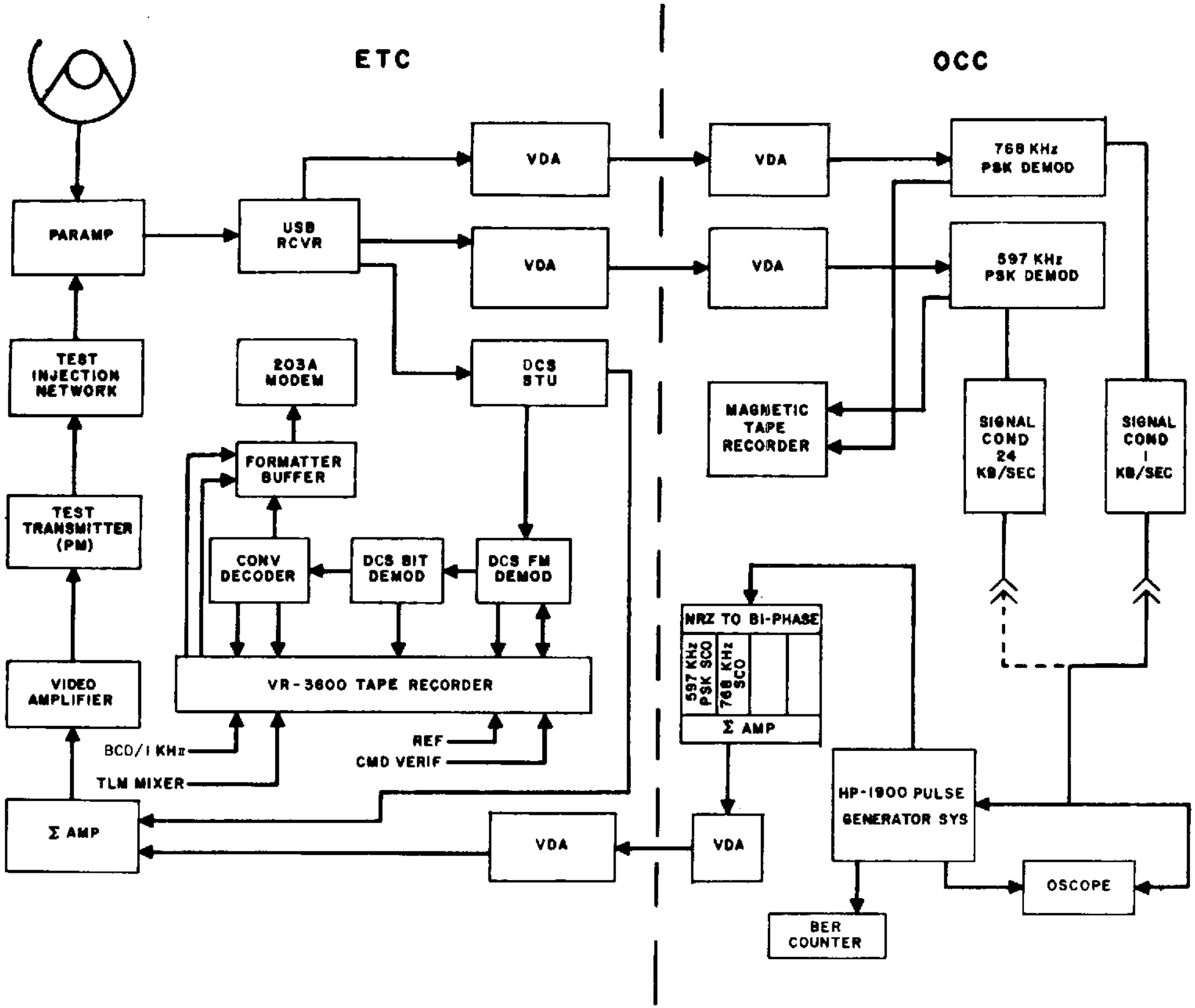


Figure 1-2. S-band PM Downlink Configuration (ETC/OCC)

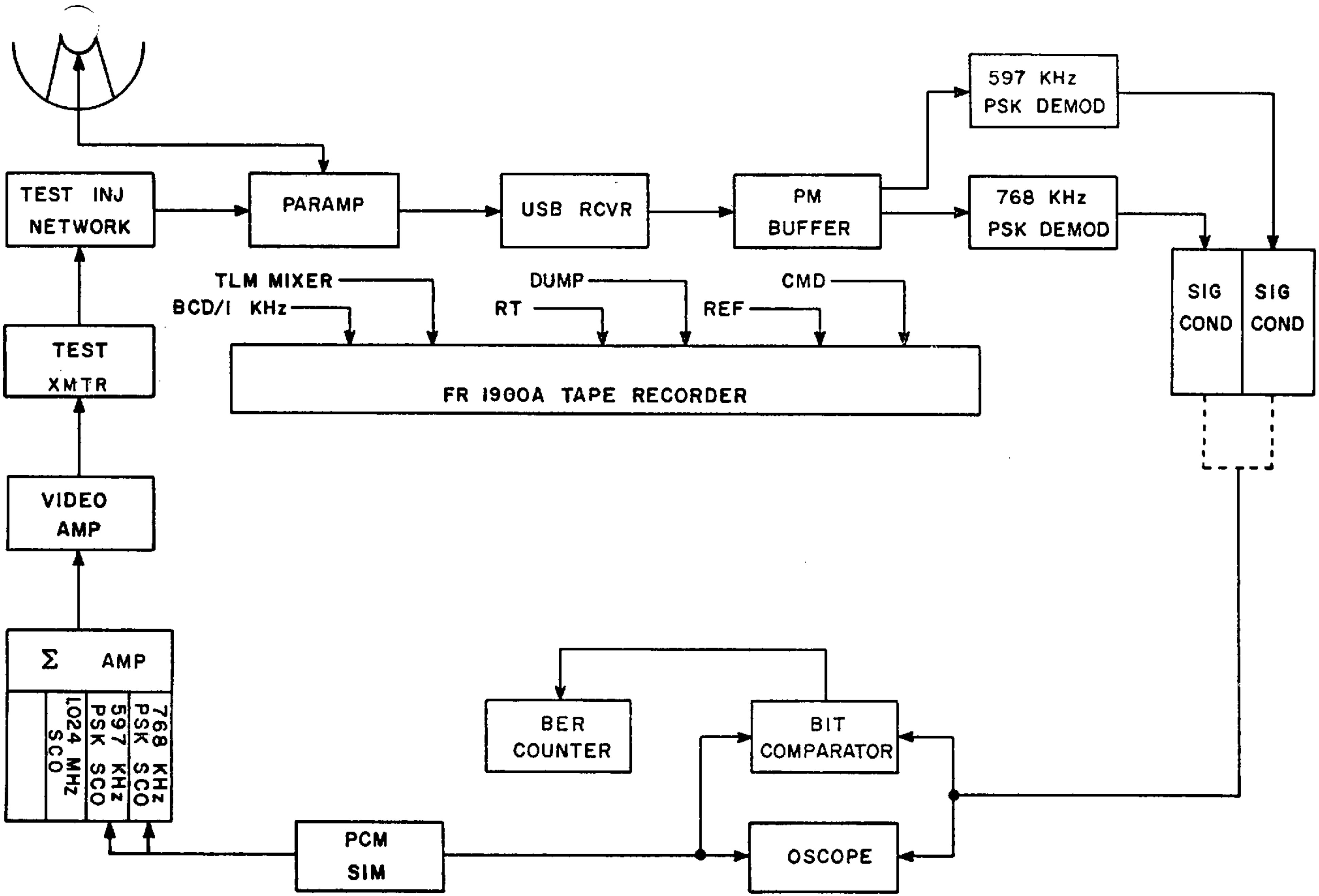


Figure 1-3. S-band PM Downlink Configuration (USB Backup)

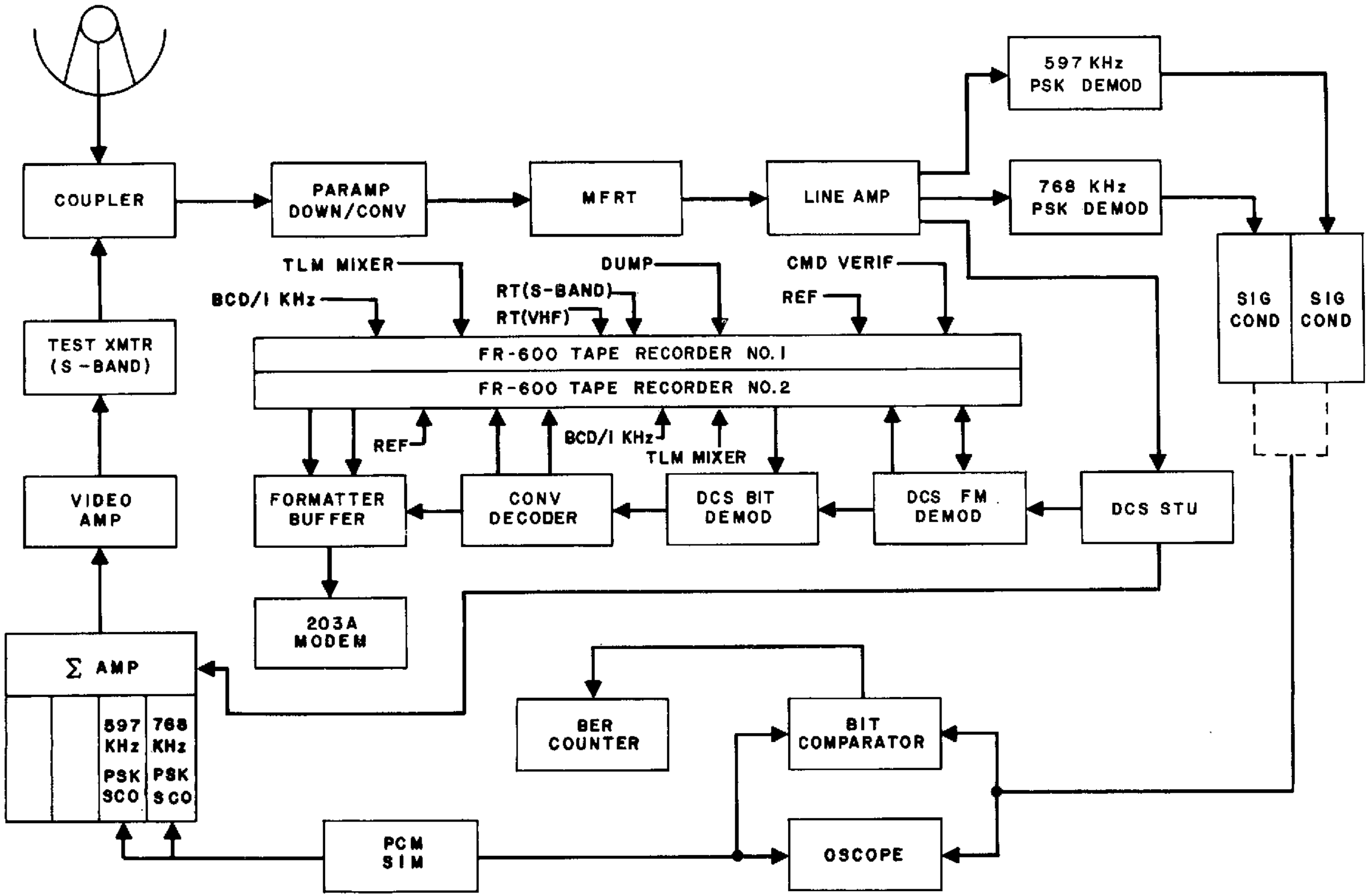


Figure 1-4. S-band PM Dowmlimk Test Configuration (Alaska)

Table 1-1. PM Downlink Test Parameters

Parameter/Equipment	Value/Setting
S-band Carrier Frequency	2287.5 MHz
Total Carrier Suppression	4.0 dB
USB RCVR Parameters	Per NOSP (STDN 601/ERTS)
Mfr RCVR Parameters	Per NOSP (STDN 601/ERTS)
PSK S/C Discriminators	Per NOSP (STDN 601/ERTS)
Signal Conditioner	Per NOSP (STDN 601/ERTS)
PCM Simulator	Per Appendix E
Bit Comparator	Per Appendix E
Bit Error Counter	Per Appendix E
PSK Simulator	Per Appendix E

Table 1-2. DCS Equipment Test Settings

Equipment	Control/Switch	Indication
FM Demod	AUTO/MANUAL	AUTO
	PLAYBACK	OFF
	CHANNEL STATUS	SELECT 1,2,3,4,5,6
	INHIBIT	OFF
Bit Demod	INPUT SOURCE	RECEIVER
Conv. Decoder	MODE	OPERATE
	AUTO HALT/FREE RUN	FREE RUN
Self-test Unit	VCO AUTO/MAN	AUTO
	VCO ON/OFF	ON
	NOISE ON/OFF	OFF
	C/KT ADJUST	+2
	MODE SEL	TEST
	STU/RECEIVER	RECEIVER
	RUN/HOLD	RUN
	MESSAGE SEL	$\overline{\text{PRN}}$
	TIME DELAY	6 msec
	DISPLAY	OFF
Formatter Buffer	DATA SOURCE	DECODER
	REQUEST TO SEND	ON
	HEADER SOURCE	
	Alaska	367
	Goldstone	260
	NTTF	130
	DESTINATION CODE	177
	DATA FORMAT	156
	BURST/CONT.	BURST
	MASTER CLEAR	Press to clear
Time Code Reader	POLARITY	+ (Plus)
	FWD/REV	FWD
	CODE	N3

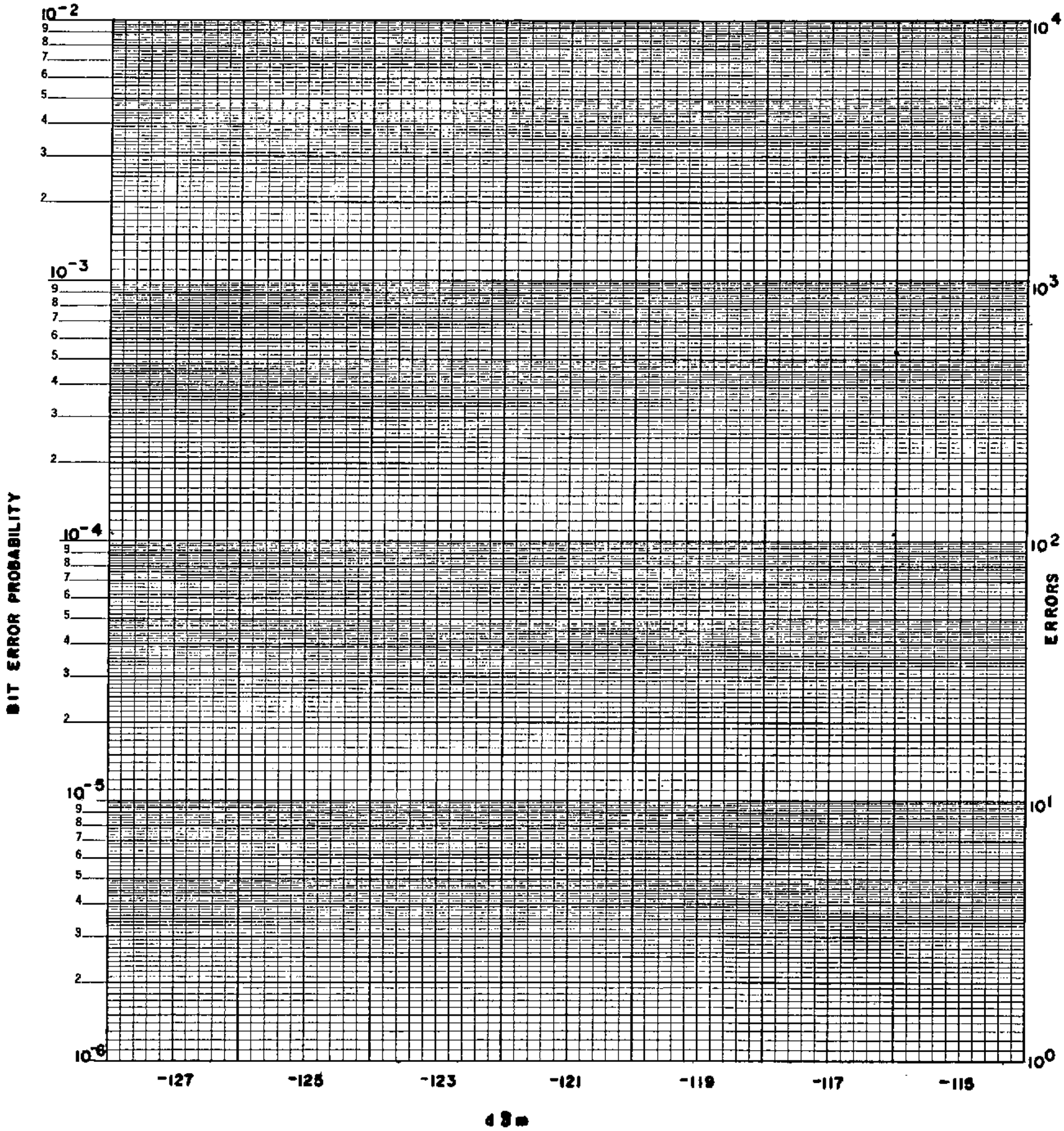


Figure 1-5. 1.0-kb/sec Data Graph

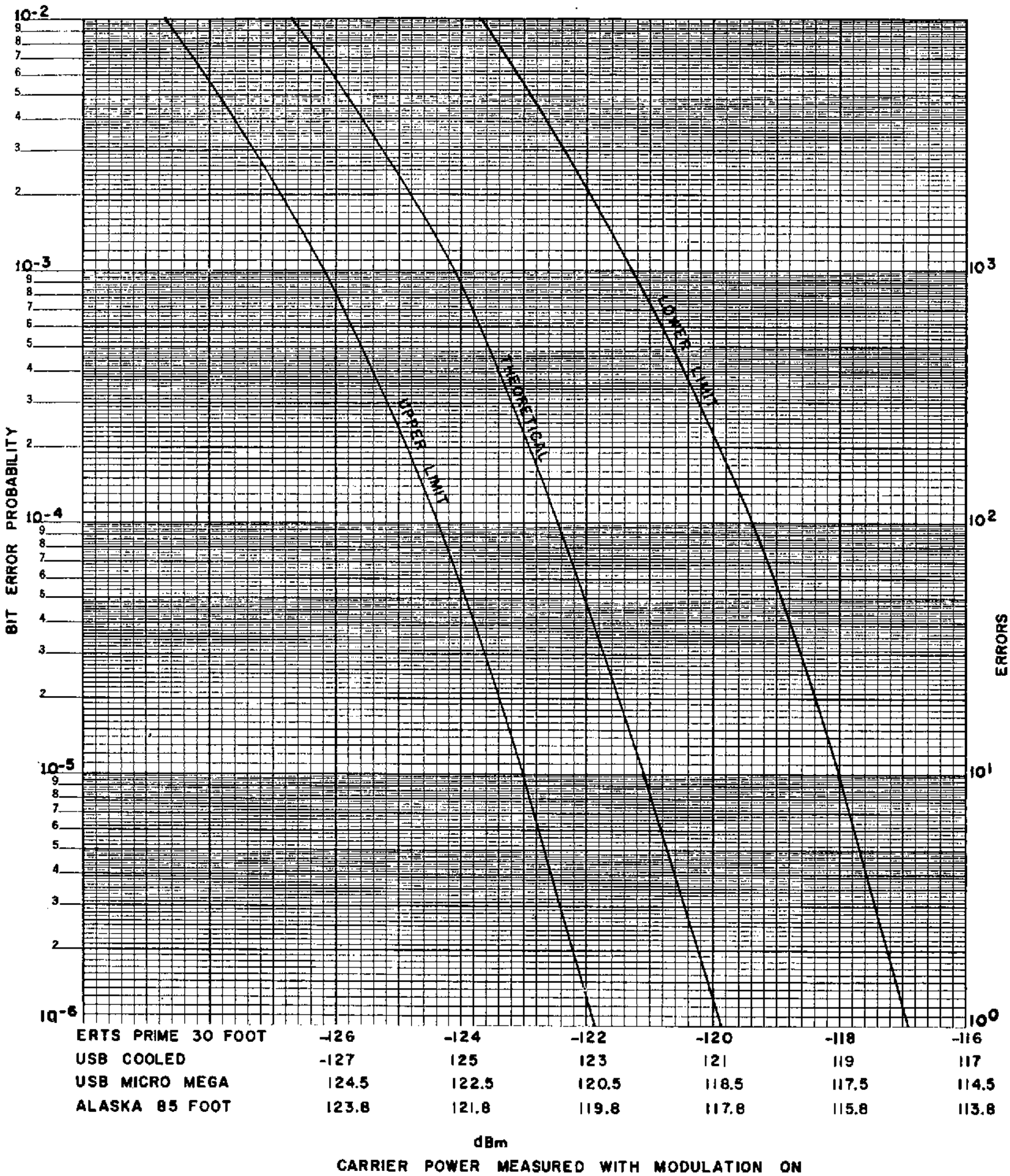


Figure 1-6. ERTS 1 kb/sec BER Test Criteria

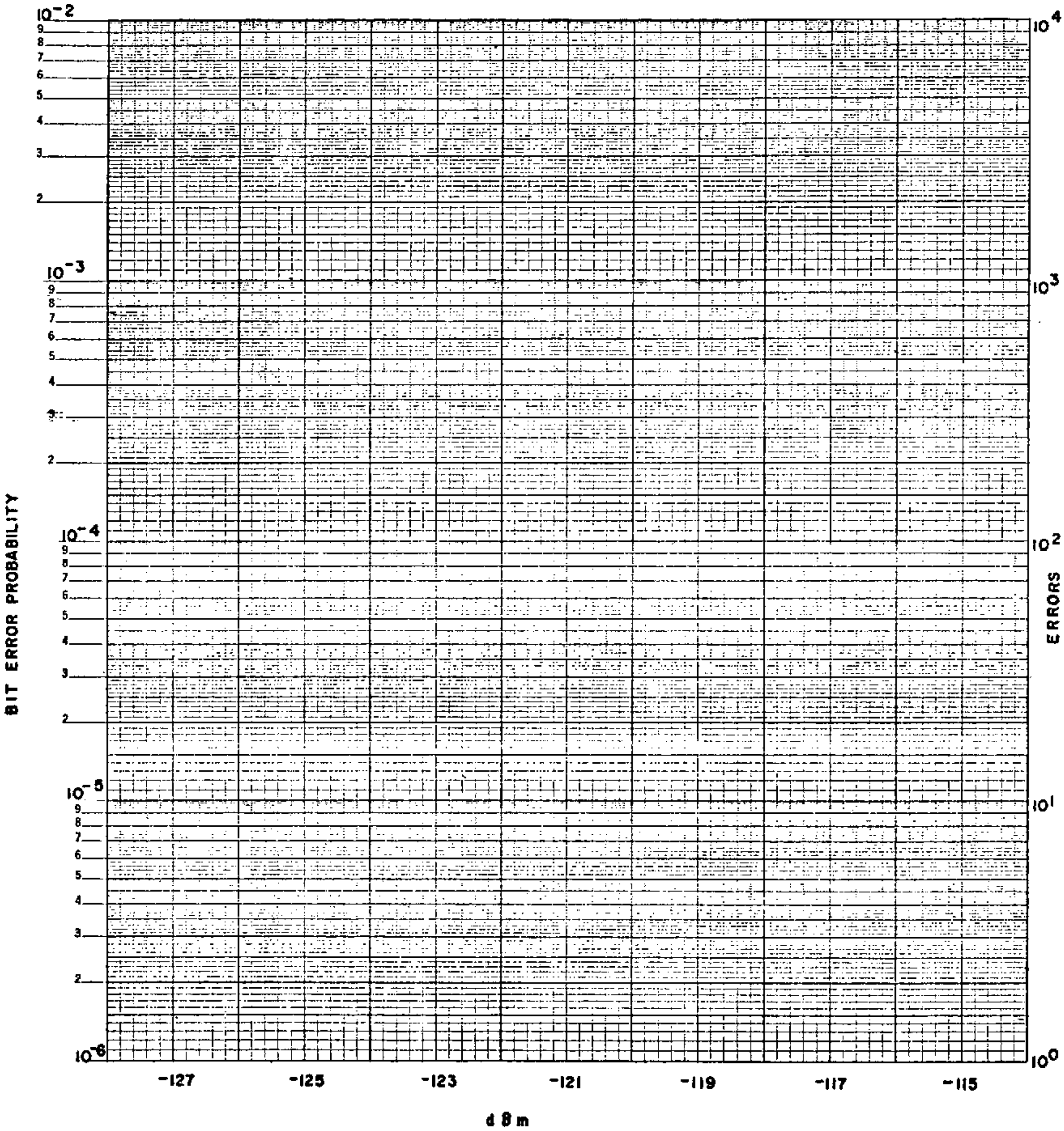


Figure 1-7. 24-kb/sec Data Graph

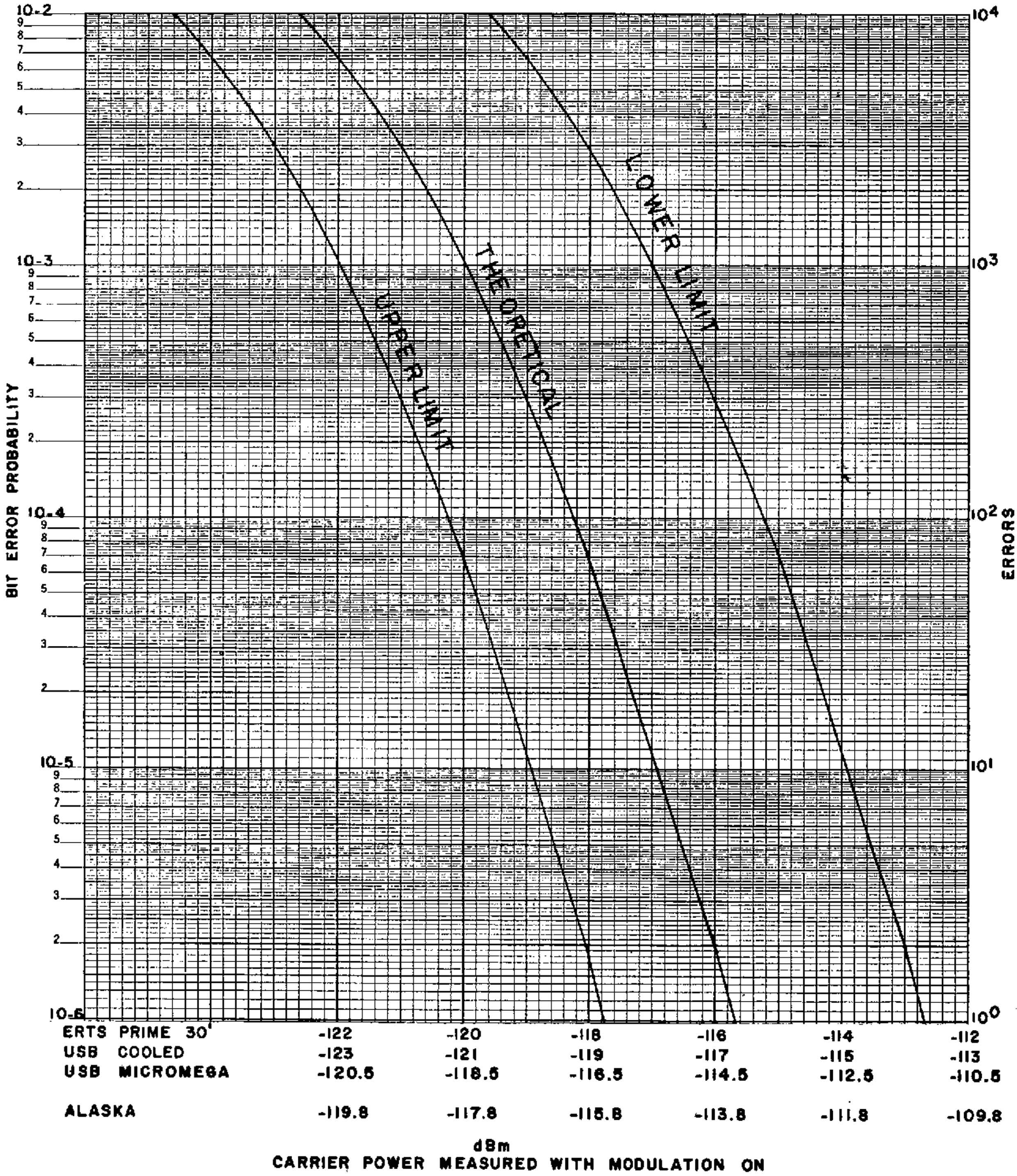


Figure 1-8. ERTS 24-kb/sec BER Test Criteria

1.2 MSS FM DOWNLINK DATA TEST

OBJECTIVE

The objective of this test is to determine the integrated systems performance from the parametric amplifier input through postdetection of the data stream.

TEST DESCRIPTION

The test objective is accomplished by modulating the FM test transmitter with simulated mission data. The output of the test transmitter is injected into the parametric amplifier and postdetection bit errors are measured.

TEST EQUIPMENT REQUIRED

The following test equipment or equivalent is required in the performance of this test:

a. MSS RSE test set.

b. Video amplifier, C-COR-4953B.

c. FM test transmitter (refer to para 1.2.1.2).

d. Power divider.

e. Power meter, HP-431.

f. Spectrum analyzer, HP-8551.

g. Test injection network.

h. Variable attenuator, Narda-784.

i. Frequency counter, HP-5245L.

j. Oscilloscope, Tektronix 547.

k. RMS digital voltmeter, HP-3403A.

l. RF millivoltmeter, HP-411A.

1.2.1 GENERAL

1.2.1.1 The Network Test and Training Facility (NTTF) Earth Resources Technology Satellite (ERTS) Station (ETC) will coordinate this test with the ERTS Operations Control Center (OCC) since all detection and simulation equipments are physically located at the ERTS OCC. ERTS OCC ground station personnel will perform the MSS and RCDR operator functions of this test.

1.2.1.2 The ETC station test conductor (TC) is the coordinator for this test and will require MSS data support from the ERTS OCC.

1.2.1.3 Unified S-band (USB) stations will utilize the Microdyne Model 7100 test transmitter in the performance of this test. Alaska will utilize the Radiation Systems, Inc., calibration signal generator as the test transmitter. The modulation index of the test transmitter should be established utilizing Appendix A and verified by measuring the wideband demodulator output (wideband demod output volts peak-to-peak times wideband demod sensitivity MHz/volt = peak-to-peak deviation).

1.2.1.4 Bit error rate test criteria included in this test (see figures 1-9, 1-10, and 1-11) is for information only. Stations will be provided with the test equipment and procedures for performing the bit error rate test at a future date.

1.2.2 TEST PROCEDURES

Use the following procedures to perform the MSS FM downlink data test:

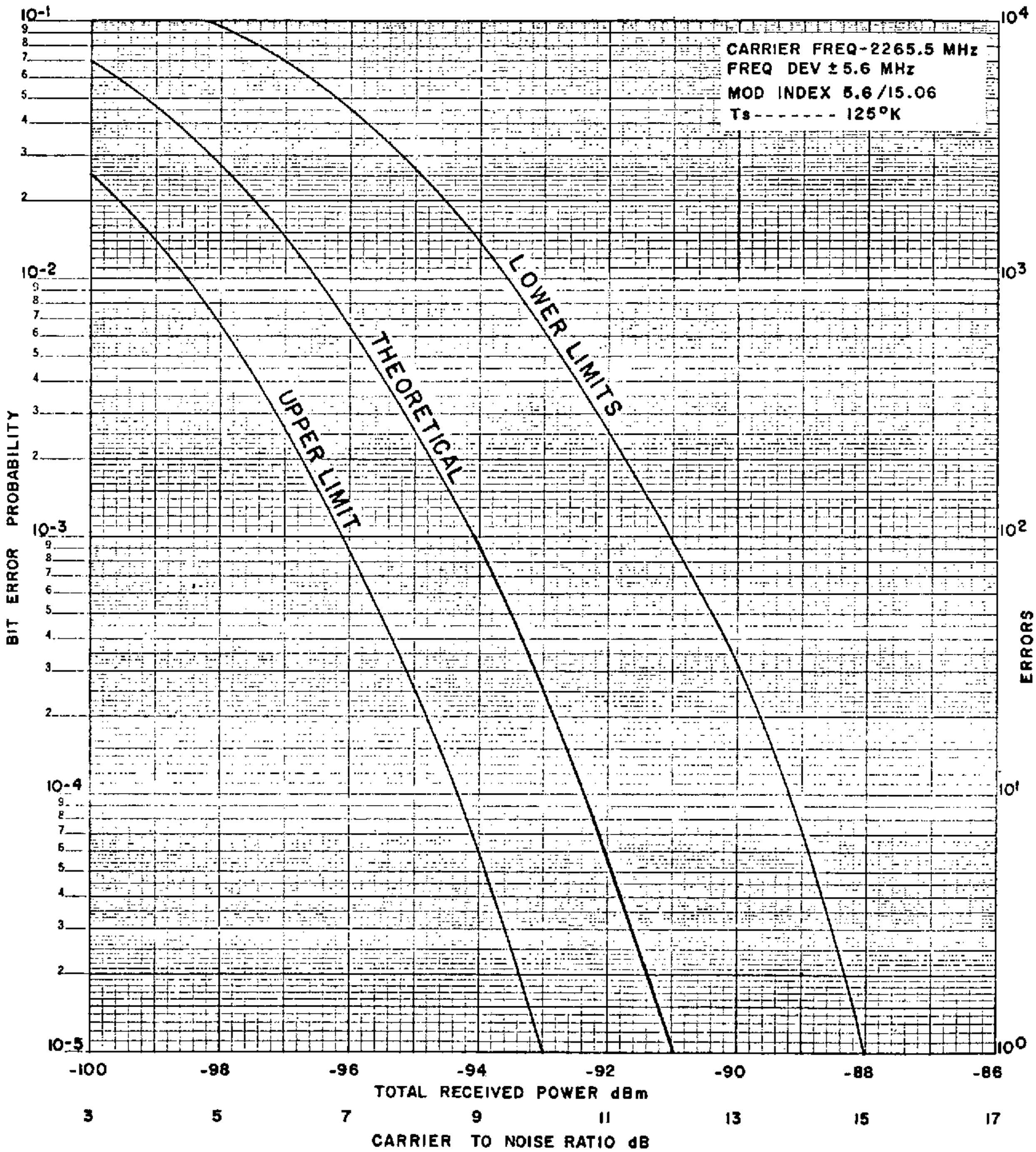


Figure 1-9. MSS Test Criteria (ETC and GDS)

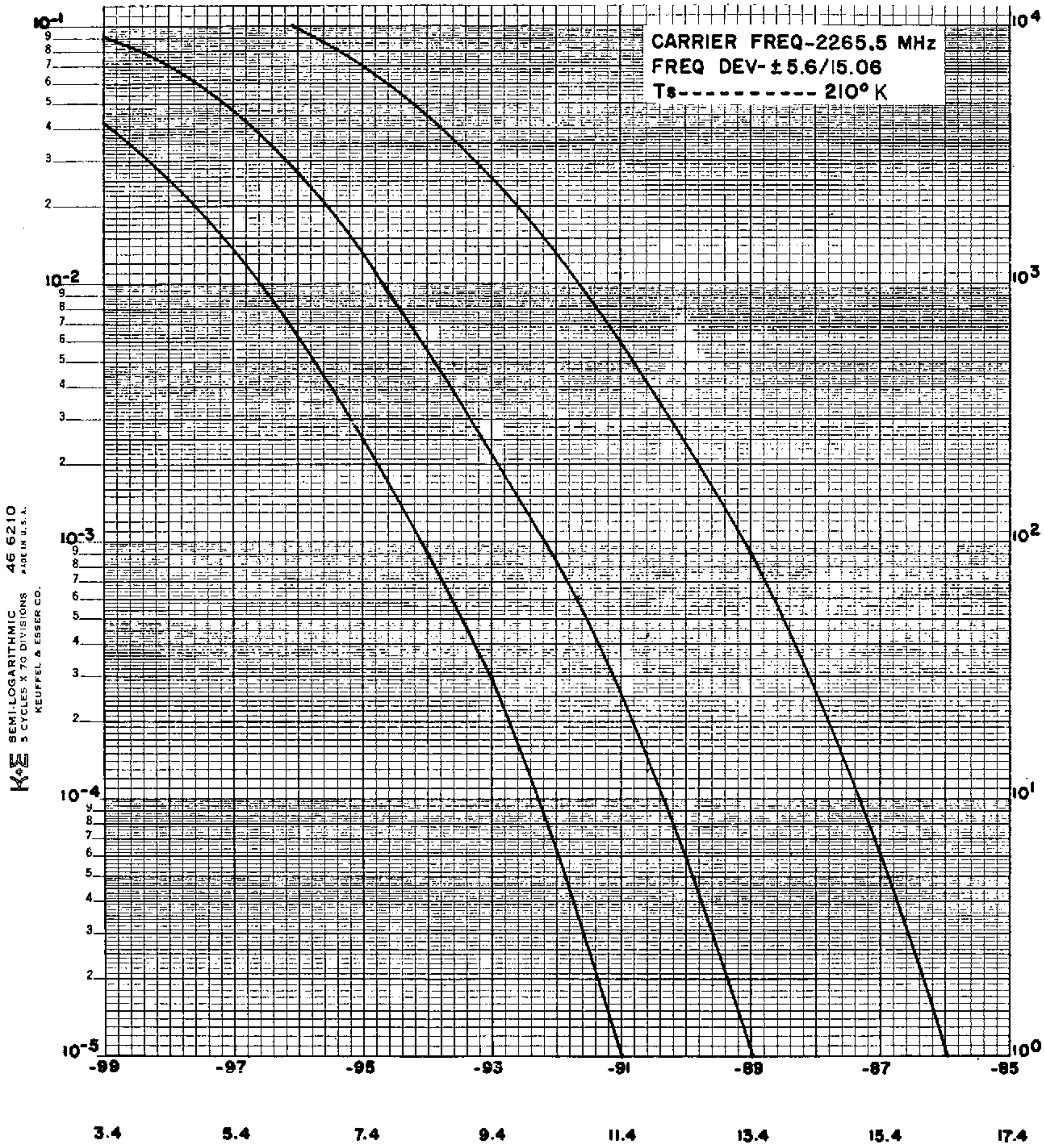


Figure 1-10. MSS Test Criteria (ULA)

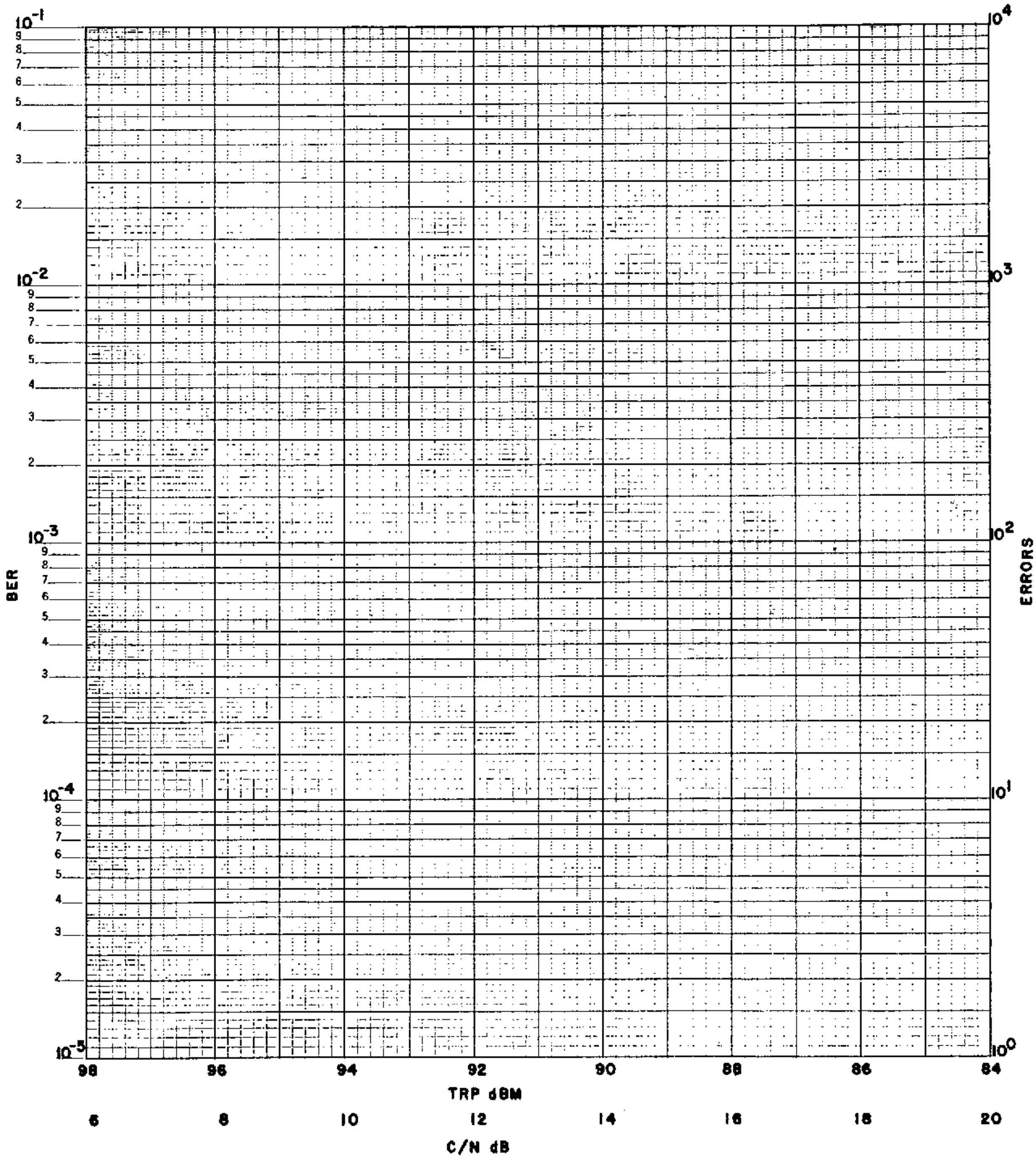


Figure 1-11. MSS Performance Data

MSS FM Downlink Data Test

Seq	Test	Operator	Instructions
1	C:N	USB/MFR/MSS*/ RCDR*	Configure the station equipment as shown in figure 1-12, 1-13, or 1-14, as applicable. Set equipment parameters as given in table 1-3.
2	C:N	USB/MFR	Set the test transmitter output attenuator for maximum attenuation and disable the output. Connect the HP-411A RF millivoltmeter to monitor the receiver IF input to the FM demodulator. Verify that the MFR AGC is disabled and the receiver is operating in a MANUAL GAIN mode. Note the IF noise level reference as read on the HP-411A.
3	C:N	USB/MFR	Enable the test transmitter output and adjust the output attenuator until the HP-411A indicates 3 dB above the reference level of sequence 2. Calculate the parametric amplifier input level (test transmitter output minus cable losses, coupler losses, etc.) and verify that the paramp input level is -102.4 dBm (±2 dB) at ULA and -102.9 dBm (±2 dB) at ENT and EGD.
4	S:N	USB/MFR/MSS*	Disconnect the HP-411A from the receiver IF and restore the receivers to a normal operations configuration given in STDN No. 601/ERTS. Set the test transmitter output attenuator for a -85 dBm level into the parametric amplifier. Set up the MSS test set to simulate the downlink 15.06-Mb/sec NRZ bit stream. Note ETC ERTS station personnel should verify optimum reception of the MSS 15.06 Mb/sec data from the ERTS OCC prior to setting the test transmitter deviation. Set the MSS test set 15.06-Mb/sec NRZ output to deviate the test transmitter ±5.6 MHz. The test transmitter deviation should be established using the modulation sensitivity determined by the method of Appendix A.
5	S:N	MSS*	Insert a T-connector in the video line between the FM demodulator and the model 319 bit synchronizer (T-connector must be inserted at the bit synchronizer input). Connect the oscilloscope to the bit synchronizer input T-connector. Measure the peak-to-peak signal level of NRZ data. The peak-to-peak amplitude of the NRZ data should be 5.6 V at EGD and ENT/OCC, and 3.9 V at ULA.
6	S:N	USB/MFR/MSS*	Remove modulation from the test transmitter. Disconnect the oscilloscope from the bit synchronizer input T-connector and connect the HP-3403 true RMS voltmeter to the T-connector. Measure the RMS noise level on the HP-3403.

*For ETC testing, the MSS and RCDR operators are located at the ERTS OCC.

MSS FM Downlink Data Test (cont)

Seq	Test	Operator	Instructions
7	S:N	MSS*	Using signal level measured in sequence 5 and noise level measured in sequence 6, calculate S:N ratio (20 log S:N where S = 1/2 peak-to-peak voltage) in dB. ULA should obtain a S:N ratio of 20.1 dB (±2 dB). EGD and ENT/OCC should obtain a S:N ratio of 22.4 dB (±2 dB).

*For ETC testing, the MSS and RCDR operators are located at the ERTS OCC.

MSS FM Downlink Data Test (cont)

<table>
<tr><th>Seq</th><th>Test</th><th>Operator</th><th>Instructions</th></tr>
<tr><td>8</td><td>S:N</td><td>MSS *</td><td>Disconnect the HP-3403 from the T-connector and remove the T-connector from the bit synchronizer input. Restore normal interface between the FM demodulator and bit synchronizer.</td></tr>
<tr><td>9</td><td>MNFS Errors</td><td>MSS *</td><td>At the bit synchronizer, verify that the SYNC indicator is illuminated and that the DATA indicator is extinguished.</td></tr>
<tr><td>10</td><td>MNFS Errors</td><td>MSS *</td><td>Set up the MSS test set as follows:
<table>
<tr><th>Switch</th><th>Setting</th><th>Switch</th><th>Setting</th></tr>
<tr><td>5/10 PREAMBLE</td><td>10</td><td>GENERAL WORD</td><td>011111</td></tr>
<tr><td>6/7 GOOD PRE</td><td>7</td><td>START SCAN SYNC</td><td>111000</td></tr>
<tr><td>MISS 3/4 PRE</td><td>3</td><td>MNFS WORD</td><td>001011</td></tr>
<tr><td>∿-DC</td><td>DC</td><td>PREAMBLE WORD</td><td>000111</td></tr>
<tr><td>UNIQUE SENS SEL</td><td>1</td><td>ALL WHITE</td><td>NORM</td></tr>
<tr><td>MNFS WORD MISSES</td><td>0</td><td>ALL BLACK</td><td>NORM</td></tr>
<tr><td>FIRST WORD AFTER SSSC</td><td>NORM</td><td>CLOCK SOURCE</td><td>INT.</td></tr>
<tr><td>MISS ALL MNFS</td><td>NORM</td><td>ERROR WORD CODE</td><td>000000</td></tr>
<tr><td>UNIQUE WORD</td><td>011111</td><td>SENSOR CHANNEL SEL</td><td>1</td></tr>
<tr><td>TAPE/DEMUX PBI</td><td>TAPE</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>11</td><td>MNFS Errors</td><td>USB/MFR</td><td>Set the test transmitter output for a -88 dBm signal (Alaska use -86 dBm) level into the parametric amplifier.</td></tr>
<tr><td>12</td><td>MNFS Errors</td><td>MSS *</td><td>Verify that the demultiplexer PREAMBLE SEARCH. PREAMBLE LOCK, and MNFS LOCK indicators are blinking. Connect a frequency counter to demultiplexer J-44. Set the counter FUNCTION switch to FREQUENCY and TIME BASE switch to 10 SEC.</td></tr>
</table>

*For ETC testing, the MSS operator is located at the ERTS OCC.

MSS FM Downlink Data Test (cont)

Seq	Test	Operator	Instructions
13	MNFS Errors	MSS*	Record the error count as displayed on the frequency counter. The error count as measured on the frequency counter should not exceed 3 errors per 10 seconds.
14	Pre-amble Pattern	MSS*	Connect the oscilloscope external sync input to J-59 of the test set and set the SELF TEST SYNC SELECT to 2. Connect input 1 of the oscilloscope to the demultiplexer channels 1 through 25 in sequence and verify that the preamble word pattern (101010 or 010101) is on each output.
15	Line Start Word Pattern	MSS*	Connect the oscilloscope external sync input to J-58 of the test set. Connect input 1 of the oscilloscope to the demultiplexer channels 1 through 25 in sequence and verify that the line start word pattern (111001) is on each output.
16	MNFS	MSS*	Set the test set MNFS WORD MISSES switch to 3 and verify that the demultiplexer MINOR FRAME LOCK indicator remains blinking.
17	MNFS	MSS*	Set the test set MNFS WORD MISSES switch to MISS 4 MNFS WORDS. Verify that the demultiplexer MINOR FRAME SEARCH indicator is blinking and the MINOR FRAME LOCK indicator is extinguished.
18	MNFS	MSS*	Set the test set MNFS WORD MISSES switch to 0 and MISS ALL MNFS WORDS switch to ALL. Verify that the demultiplexer MINOR FRAME SEARCH indicator is blinking and the MINOR FRAME LOCK indicator is extinguished. Return MISS ALL MNFS WORDS switch to NORM.
19	Pre-amble	MSS*	Set the test set 5/10 MS PREAMBLE switch to 10 and MISS 3 or 4 PREAMBLE WORDS switch to 4. Verify that the demultiplexer MINOR FRAME SEARCH and LOCK indicators are extinguished. Return MISS 3 or 4 PREAMBLE WORDS switch to 3.
20	Pre-amble	MSS*	Set the test set 5/10 MS PREAMBLE switch to 5 and 6 or 7 GOOD PREAMBLE WORDS switch to 6. Verify that the demultiplexer PREAMBLE LOCK, MINOR FRAME SEARCH and MINOR FRAME LOCK indicators are extinguished. Return the 6 or 7 GOOD PREAMBLE WORDS switch to 7 and 5/10 MS PREAMBLE switch to 10.

* For ETC testing, the MSS operator is located at the ERTS OCC.

MSS FM Downlink Data Test (cont)

Seq	Test	Operator	Instructions
21	Word Mon	MSS *	Set the test set UNIQUE WORD CODE switches and GENERAL WORD CODE switches to 111111. Set the demux CHANNEL SELECT to 1. Connect a digital voltmeter to demultiplexer J-35 and measure the voltage level at J-35. Measured voltage should be 5002 mV (±200 mV).
22	Word Mon	MSS *	Repeat sequence 21 for demultiplexer CHANNEL SELECT positions 2 through 26.
23	Word Mon	MSS *	Set the test set UNIQUE WORD CODE switches and GENERAL WORD CODE switches to 100000. Measure the voltage at demultiplexer J-35 on the digital voltmeter. The meter should read 2540 mV (±200 mV).
24	Word Mon	MSS *	Repeat sequence 23 for each position of the demultiplexer CHANNEL SELECT switch.
25	Word Mon	MSS *	Set the test set UNIQUE WORD CODE switches and GENERAL WORD CODE switches to 010000. Measure the voltage at demultiplexer J-35 on the digital voltmeter. The meter should read 1270 mV (± 200 mV).
26	Word Mon	MSS *	Repeat sequence 25 for each position of the demultiplexer CHANNEL SELECT switch.
27	Word Mon	MSS *	Set the test set UNIQUE WORD CODE switches and GENERAL WORD CODE switches to 001000. Measure the voltage at demultiplexer J-35 on the digital voltmeter. The meter should read 635 mV (±40 mV).
28	Word Mon	MSS *	Repeat sequence 27 for each position of the demultiplexer CHANNEL SELECT switch.

*For ETC testing, the MSS operator is located at the ERTS OCC.

MSS FM Downlink Data Test (cont)

Seq	Test	Operator	Instructions
29	Word Mon	MSS *	Set the test set UNIQUE WORD CODE switches and GENERAL WORD CODE switches to 000100. Measure the voltage at demultiplexer J-35 on the digital voltmeter. The meter should read 317 mV (±40 mV).
30	Word Mon	MSS *	Repeat sequence 29 for each position of the demultiplexer CHANNEL SELECT switch.
31	Word Mon	MSS *	Set the test set UNIQUE WORD CODE switches and GENERAL WORD CODE switches to 000010. Measure the voltage at demultiplexer J-35 on the digital voltmeter. The meter should read 158 mV(±40 mV).
32	Word Mon	MSS *	Repeat sequence 31 for each position of the demultiplexer CHANNEL SELECT switch.
33	Word Mon	MSS *	Set the test set UNIQUE WORD CODE switches and GENERAL WORD CODE switches to 000001. Measure the voltage at demultiplexer J-35 on the digital voltmeter. The meter should read 79 mV(±40 mV).
34	Word Mon	MSS *	Repeat sequence 33 for each position of the demultiplexer CHANNEL SELECT switch.
35	Word Mon	MSS *	Set the test set UNIQUE WORD CODE switches and GENERAL WORD CODE switches to 000000. Measure the voltage at demultiplexer J-35 on the digital voltmeter. The meter should read 0.0 mV(±40 mV).
36	Word Mon	MSS *	Repeat sequence 35 for each position of the demultiplexer CHANNEL SELECT switch.

*For ETC testing, the MSS operator is located at the ERTS OCC.

MSS FM Downlink Data Test (cont)

Seq	Test	Operator	Instructions
37	Clock	MSS *	Connect an oscilloscope to monitor the demultiplexer 2.5-MHz clock output (J-34) and verify the following: Logic 1 — +2.3 volts minimum Logic 0 — +0.45 volt maximum Rise Time (10% to 90%) — less than 100 nsec Fall Time (90% to 10%) — less than 100 nsec
38	Clock	MSS *	Repeat sequence 37 substituting 100-kHz clock output (J-33) for the 2.5-MHz clock output.
39	Clock	MSS *	Repeat sequence 37 substituting 600-kHz clock output (J-32) for the 2.5-MHz clock output.
40	Clock	MSS *	Connect a frequency counter to J-34 of the demultiplexer and set the counter for a period measurement. Period measurement for the 2.5-MHz clock should be 400 nanoseconds ±5 percent.
41	Clock	MSS *	Disconnect the frequency counter from J-34 and connect to J-33. Period measurement for the 100-kHz clock should be 9.9 microseconds ±5 percent.
42	Clock	MSS *	Disconnect the frequency counter from J-33 and connect to J-32. Period measurement for the 600-kHz clock should be 1.66 microseconds ±5 percent. Disconnect the counter from J-33.
43	Tape	MSS/RCDR *	Reset the test set UNIQUE WORD CODE switches and GENERAL WORD CODE switches to 011111. Set the ∿/DC switch to ∿UNIQUE. Set the UNIQUE SENSOR SELECT switch to 1.
44	Tape	RCDR *	Load the tape recorder with a clean tape. Verify signal presence and correct record level of each data stream at the FR-1928 magnetic tape recorder inputs.
45	Tape	MSS/RCDR *	Start the FR-1928 magnetic tape recorder in a simultaneous record/reproduce mode. (All FR-1928 data and clock playback channels should be patched to the MSS test set).
46	Tape	MSS *	Set the MSS test set SENSOR CHANNEL SELECT switch to position 1.
47	Tape	MSS *	Verify the presence of a 5-Vpp triangular waveform with a period of 1.3 milliseconds as measured on the status monitor oscilloscope.

*For ETC testing, the MSS and RCDR operators are located at the ERTS OCC.

MSS FM Downlink Data Test (cont)

Seq	Test	Operator	Instructions
48	Tape	MSS *	Set the MSS test set UNIQUE SENSOR SELECT and SENSOR CHANNEL SELECT switches to position 2. Repeat sequence 47.
49	Tape	MSS *	Repeat sequences 47 and 48 for positions 3 through 26 of the UNIQUE SENSOR SELECT and SENSOR CHANNEL SELECT switches. The period of the triangular waveform will be approximately 3.8 milliseconds for channels 25 and 26.
50	Time Interval	MSS *	Reset the MSS test set UNIQUE SENSOR SELECT and SENSOR CHANNEL SELECT switches to position 1. Set the ~/DC switch to DC.
51	Time Interval	MSS *	Verify that the test set TIME INTERVAL MEASUREMENT display indicates 010 011 000 000 000 111.
52	Time Interval	MSS *	Set the ALL BLACK CODE switch to 15 and ALL WHITE CODE switch to 3. Verify that the TIME INTERVAL MEASUREMENT display indicates 010 011 000 000 000 111.
53	Time Interval	MSS *	Set the test set ALL WHITE CODE switch to NORMAL. Verify that the TIME INTERVAL MEASUREMENT display indicates 010 011 000 000 000 111.
54	Time Interval	MSS *	Set the test set ALL BLACK CODE switch to 14 and ALL WHITE CODE switch to 3. Verify that the TIME INTERVAL MEASUREMENT display indicates 010 011 000 000 000 111.
55	Time Interval	MSS *	Set the 5/10 MS PREAMBLE switch to 5 and repeat sequences 51 through 54. TIME INTERVAL MEASUREMENT display should indicate 010 100 111 111 111 000 in each sequence.
56	Time Interval	MSS *	Set the test set ALL BLACK CODE switch to 14 and ALL WHITE CODE switch to 2. Verify that the TIME INTERVAL MEASUREMENT display indicates 111 111 111 111 111 111.
57	Time Interval	MSS *	Set the ALL BLACK CODE switch to 15 and ALL WHITE CODE switch to 2B1. Verify that the TIME INTERVAL MEASUREMENT display indicates 111 111 111 111 111 111. Reset ALL BLACK CODE and ALL WHITE CODE switches to NORMAL.

*For ETC testing, the MSS operator is located at the ERTS OCC.

Seq	Test	Operator	Instructions
58	Data Polarity	MSS*	Set the test set controls as follows: Control — Setting UNIQUE WORD CODE — 000111 GENERAL WORD CODE — 111000 6/7 GOOD PREAMBLE WORD — 6 UNIQUE SENSOR SELECT — 1 SENSOR CHANNEL SELECT — 1 Set the demultiplexer controls as follows: Control — Setting CHANNEL SELECT — 1 DATA POLARITY — INVERTED
59	Data Polarity	MSS*	Verify that the test set SELECTED SENSOR DATA display indicates 111000 for demultiplexer channel 1 and 000111 for demultiplexer channels 2 through 26.
60	Data Polarity	MSS*	Set the test set UNIQUE WORD CODE switches to 111000 and GENERAL WORD CODE switches to 000111. Verify that the test set SELECTED SENSOR DATA display indicates 000111 for demultiplexer channel 1 and 111000 for demultiplexer channels 2 through 26.
61	Data Polarity	MSS/RCDR*	Stop the FR-1928 tape recorder and reset the demultiplexer DATA POLARITY switch to NORMAL.
62	Tape	MSS/RCDR*	Configure the TR-70 video tape recorder for MSS support. Verify correct level of 15.06-Mb/sec data and clock at the recorder input.
63	Tape	MSS/RCDR*	Install a degaussed scratch tape on the TR-70 transport. Start the TR-70 and record 3 to 5 minutes of data on the tape. Stop the recorder and rewind the tape to the beginning of the recorded data.

* For ETC testing, the MSS and RCDR operators are located at the ERTS OCC.

MSS FM Downlink Data Test (cont)

Seq	Test	Operator	Instructions
64	Tape	MSS/RCDR*	Configure the TR-70 recorder to play back the recorded data into the MSS bit synchronizer. Set up the status monitor oscilloscope to monitor the demultiplexer output. Set the demultiplexer CHANNEL SELECT switch to position 1.
65	Tape	MSS/RCDR*	Start the TR-70 tape recorder in a REPRODUCE mode and verify lock on the bit synchronizer and demultiplexer. Verify correct display on the status monitor oscilloscope for each position of the demultiplexer CHANNEL SELECT switch. Oscilloscope display should be 4.4 Vdc for position 1 and 0.55V for the remaining positions.
66	Tape	USB/MFR/MSS/ RCDR*	Terminate test and verify mission interface configuration.

* For ETC testing the MSS and RCDR operators are located at the ERTS OCC.

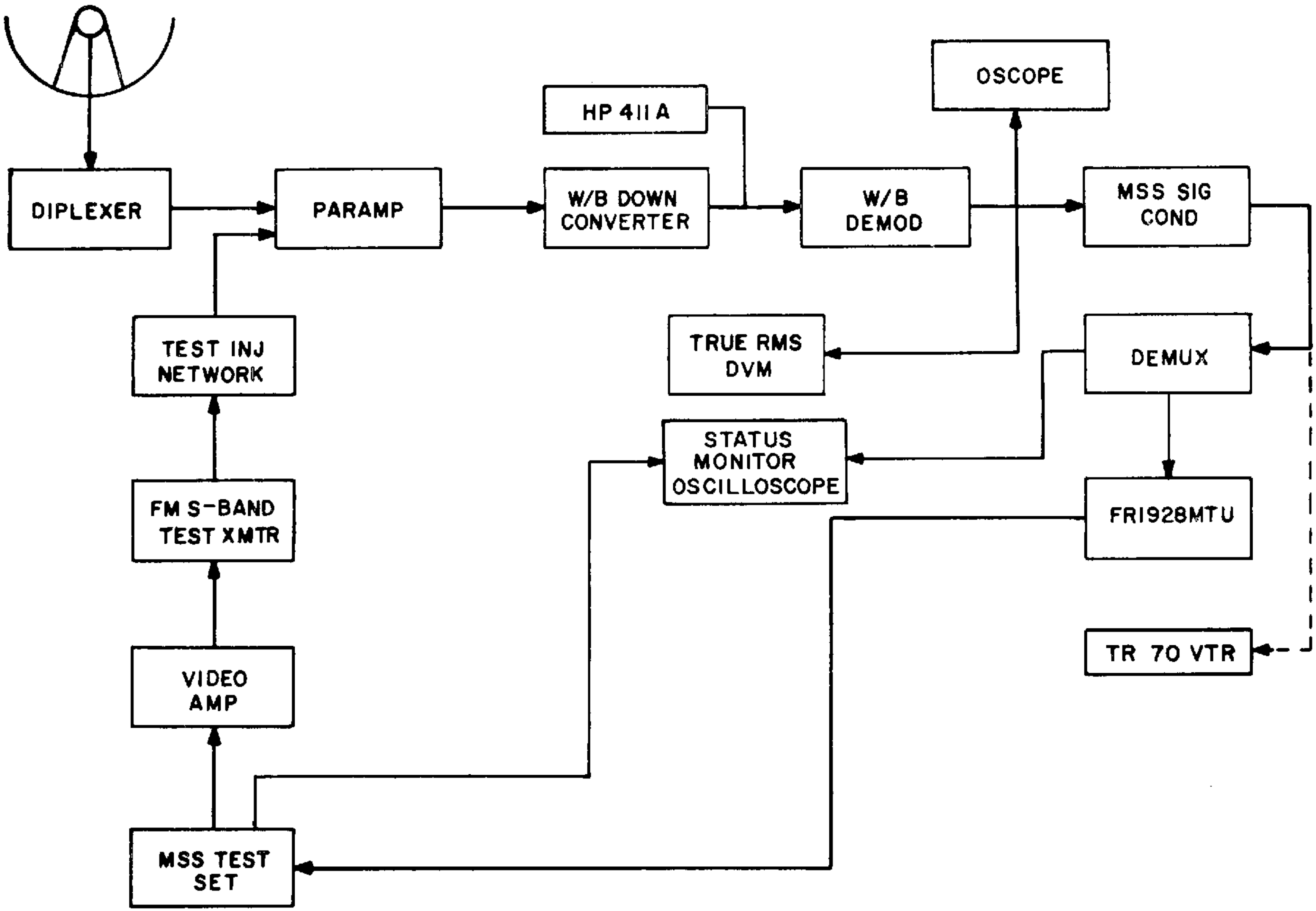


Figure 1-12. MSS Test Configuration (GDS)

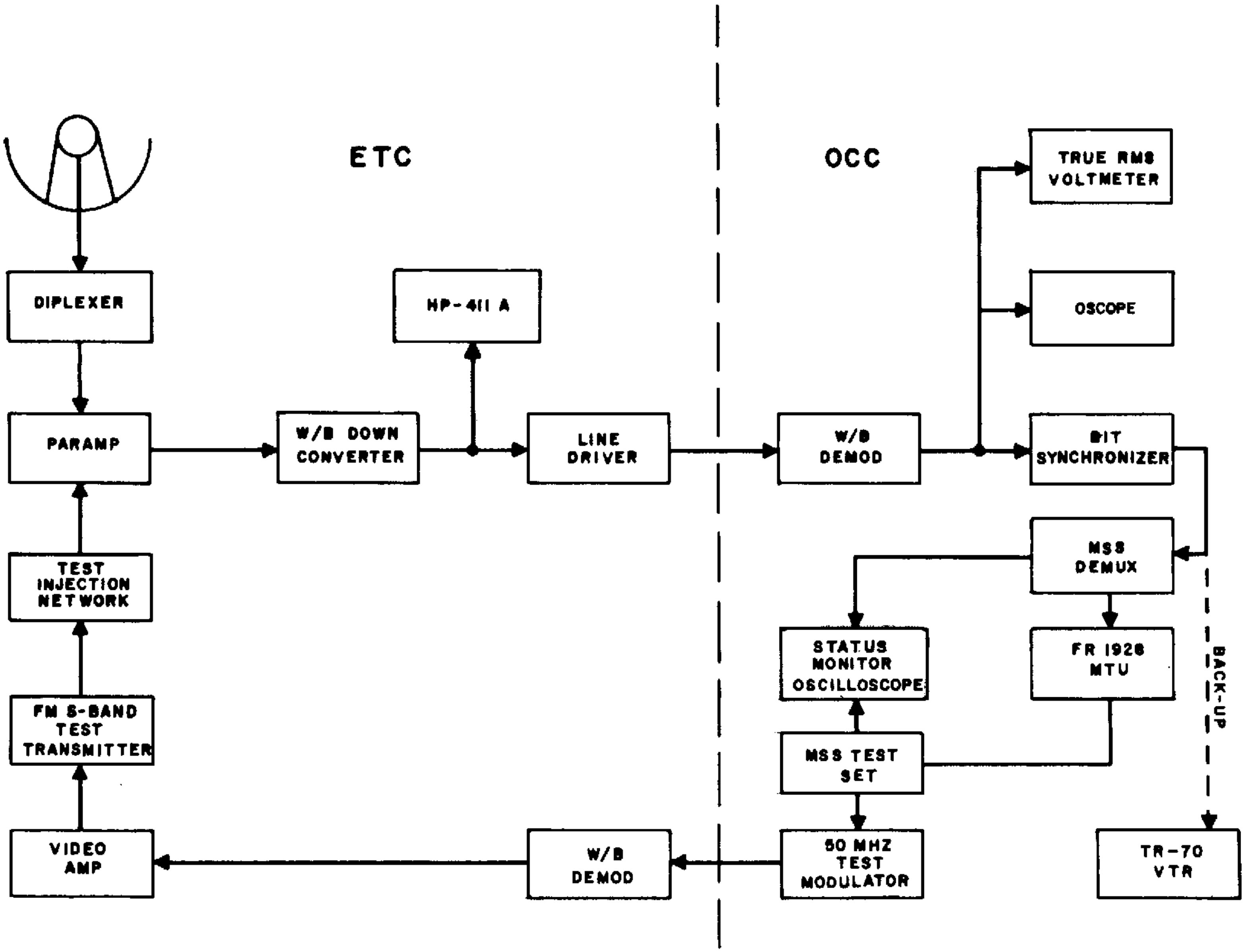


Figure 1-13. MSS Test Configuration (ETC/OCC)

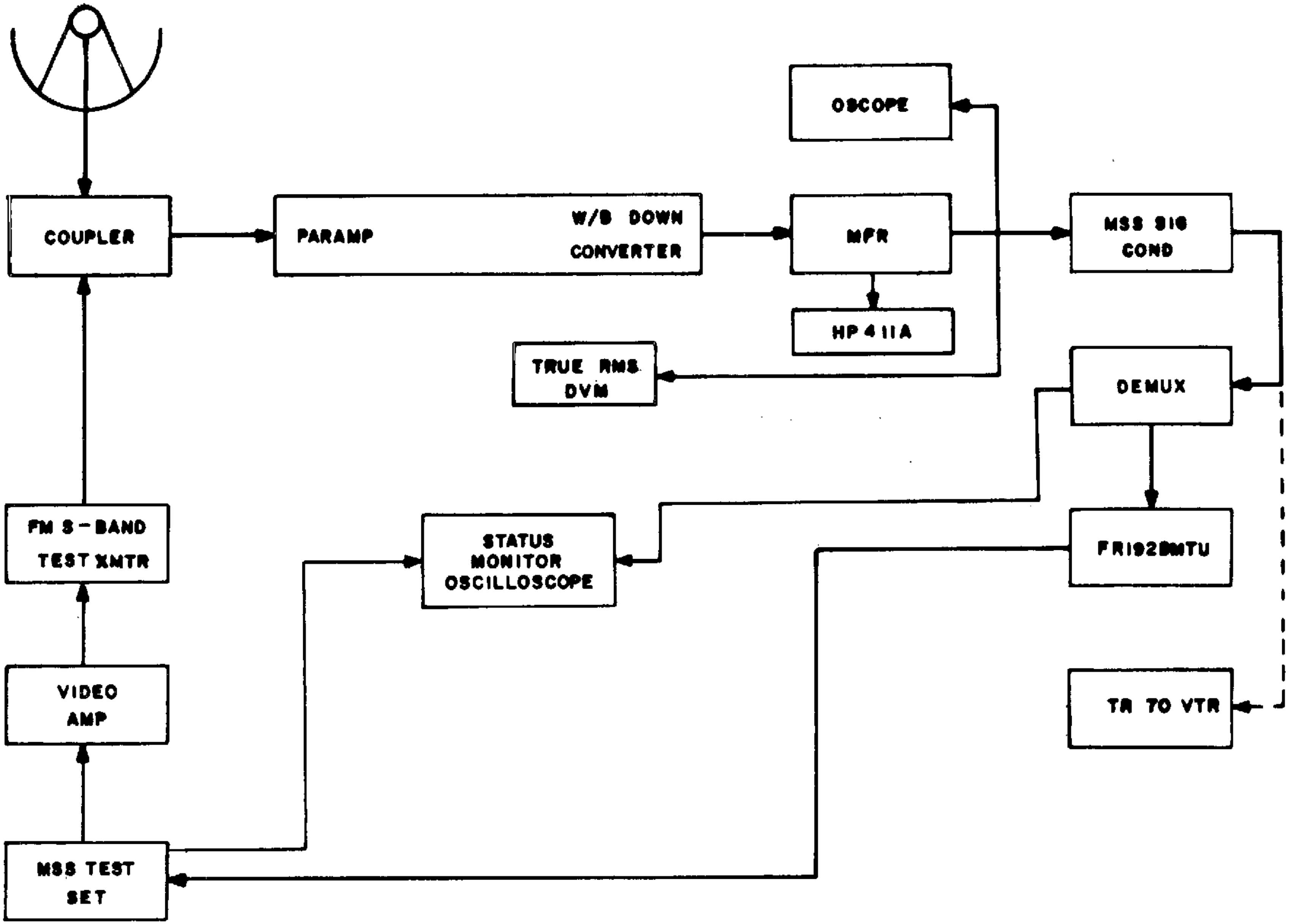


Figure 1-14. MSS Test Configuration (ULA)

Table 1-3. Equipment Setup

Equipment/Parameter	Setting/Indication
Test transmitter	
Frequency	2265.5 MHz
Deviation	±5.6 MHz
Output Level	-80 dBm
Wideband downconverter	
Frequency	2265.5 MHz
Bandwidth	30.0 MHz
Wideband demodulator *	
Input bandwidth	20 MHz
Mode	LOCAL
Video bandwidth	10 MHz
Video output level	5.6 Vpp
MFR receiver	
Band select	2200 MHz
Channel select	465.5 MHz
IF bandwidth	20 MHz
Mode select	FM
Video bandwidth	10 MHz
Video output level	3.9 Vpp
Tuning mode	OPEN LOOP
Tracking bandwidth	300 Hz
AGC bandwidth	30 msec
Bit synchronizer*	
SOURCE	FM demod (1)
POLARITY	Normal
Bandwidth	2
Demultiplexer *	
Data phase	Normal
Delay IN-OUT PBI	OUT
START OF SCAN CODE	PRMBL + SMC1 + MNFS

* For ETC Testing, Equipment is located at OCC.

1.3 RBV FM DOWNLINK TEST

OBJECTIVE

The objective of this test is to verify the integrated systems performance from parametric amplifier input through postdetection of the video data.

TEST DESCRIPTION

The test objective is accomplished by modulating the FM test transmitter Test Pattern Generator (TPG). The output of the test transmitter is injected into the parametric amplifier and postdetection signal-to-noise and video quality are measured.

TEST EQUIPMENT REQUIRED

The following test equipment or equivalent is required for the performance of this test:

a. RBV TPG.

b. HP-180 oscilloscope.

c. Video amplifier, C-COR 4953.

d. FM test transmitter (refer to para 1.3.1.1).

e. Power divider.

f. Power meter, HP-431.

g. Spectrum analyzer, HP-8551.

h. Directional coupler.

i. Test injection network.

j. Variable attenuator, Narda 784.

k. Dual-channel oscilloscope, Tektronix 547.

l. RMS digital voltmeter, HP-3403A.

m. HP-197A oscilloscope camera.

n. HP-5245L counter w/HP-5262A TIU.

o. HP-411A RF millivoltmeter.

1.3.1 GENERAL

1.3.1.1 The Network Test and Training Facility (NTTF) and the Earth Resources and Technology Satellite (ERTS) station (ETC) should coordinate this test with the ERTS Operations Control Center (OCC) since all detection and simulation equipment is physically located at the ERTS OCC. ERTS OCC ground station personnel will perform the RBV and TR-70 operator functions of this test.

1.3.1.2 The ETC station test conductor (TC) is the coordinator for this test and will require RBV data support from the ERTS OCC.

1.3.1.3 Care should be exercised throughout the performance of this test to maintain impedance match. When tee connectors are installed to facilitate measurements, high-impedance test instruments should be used to avoid mismatch. When measurements are made at unused connections or test points, high-impedance instruments should be used with unused systems connections terminated in the specified characteristic impedance.

1.3.1.4 USB stations will utilize the Microdyne Model 7100 test transmitter in the performance of this test. Alaska will utilize the Radiation Systems, Inc., calibration signal generator as the test transmitter. The modulation index of the test transmitter should be established utilizing Appendix A and verified by measuring the wideband demodulator output (wideband demodulator output volts peak-to-peak times wideband demodulation sensitivity MHz/volt = peak-to-peak deviation).

1.3.2 TEST PROCEDURES

Perform the RBV FM downlink test using the following test procedures:

RBV FM Downlink Test

Seq	Test	Operator	Instructions
1	C:N	RBV*/RCDR*/ USB/MFR	Configure the station as shown in figure 1-15, 1-16, or 1-17 as applicable. Set equipment parameters as specified in table 1-4, as applicable.
2	C:N	USB/MFR	Set the test transmitter output attenuator for maximum attenuation and disable the output. Connect the HP-411A RF millivoltmeter to monitor the receiver IF input to the FM demodulator (MFR AGC must be disabled and operating in the MGC mode). Note the IF noise level reference as read on the HP-411A.
3	C:N	USB/MFR	Enable the test transmitter output and adjust the output attenuator until the HP-411A indicates 3 dB above the reference level of sequence 2. Calculate the parametric amplifier input (test transmitter output minus cable losses, coupler losses, etc) level and verify that the paramp input level is within ±2 dB of the test criteria of item 1, table 1-5.
4	S:N	USB/MFR/RBV*	Disconnect the HP-411A from the receiver IF and restore the receivers to a normal operations configuration as specified in the ERTS NOSP, STDN No. 601/ERTS. Set the test transmitter output attenuator for a -85 dBm level into the parametric amplifier. Set the RBV TPG for a standard calibration test pattern (00) output to modulate the test transmitter ±5.6 MHz. The test transmitter deviation should be established using the modulation sensitivity determined by the method of Appendix A. Insert a tee connector in the video line between the FM demodulator and the VPASS (tee connector must be inserted at VPASS input J-5). Select FM receiver input to the VPASS and verify VPASS PLL lock. Note ETC ERTS station personnel should verify optimum reception of the RBV video data from the ERTS OCC prior to setting the test transmitter deviation.
5	S:N	RBV*	Connect the oscilloscope to the VPASS input tee connector. Measure and record the peak-to-peak signal level, sync tip dc level, black reference dc level, and white reference dc level. Verify that the measured data meets the test criteria of item 2, table 1-5.
6	S:N	RBV*/USB/MFR	Disconnect the oscilloscope from the VPASS input tee connector and connect the HP-3403A to the tee connector. Remove the modulation from test transmitter and measure the rms noise level on the HP-3403A.

* For ETC testing, the RBV and RCDR operators are located at the ERTS OCC.

Seq	Test	Operator	Instructions
7	S:N	RBV *	Calculate the signal-to-noise ratio in dB (20 log peak-to-peak signal/rms noise) using the peak-to-peak signal level measured in sequence 5 and the rms noise level measured in sequence 6. Record the calculated S:N ratio (dB) on the graph of figure 1-18 or 1-19, as applicable.
8	S:N	RBV*	Verify that the S:N ratio of sequence 7 meets the test criteria of item 3, table 1-5.
9	S:N	RBV*/USB/ MFR	Disconnect the HP-3403A from the VPASS input tee connector. Reconnect modulation to the test transmitter and verify VPASS PLL lock. Decrease the test transmitter output (parametric amplifier input) level by 2 dB. Repeat sequences 5, 6, and 7.
10	S:N	RBV*/USB	Repeat sequences 9, 5, 6, and 7 until a 6-dB S:N is obtained. Record each measured data point on the graph of figure 1-18 or 1-19. Verify that all data points fall within the upper and lower limits of figure 1-18 or 1-19 as applicable. Verify that VPASS PLL lock is maintained at S:N ratio of 6 dB.
11	S:N	RBV*/USB/ MFR	Remove the tee connector from the VPASS input J-5 and restore the interface cable between VPASS J-5 and the FM demodulator output. Reset the test transmitter for a -85 dBm input to the parametric amplifier and connect modulation to the test transmitter. Verify correct indication and sequences of all VPASS front panel indicators.
12	S:N	RBV*	Install a tee connector in the VPASS video output line at VPASS J-6 and connect the oscilloscope to the tee connector. Measure the video output peak-to-peak amplitude, sync tip dc level, black reference dc level, and white reference level. Verify that the measured data meets the test criteria of item 2, table 1-5.
13	S:N	RBV*	Repeat sequence 12 for VPASS video outputs J-7, J-8, J-10, and J-11.

* For ETC testing, the RBV operator is located at the ERTS OCC.

RBV FM Downlink Test (cont)

Seq	Test	Operator	Instructions
14	S:N	RBV*/USB/ MFR	Remove the modulation from the test transmitter and reinstall the tee connector at the VPASS J-6 video output. Connect the HP-3403A to the tee connector and measure the rms noise output.
15	S:N	RBV*/USB/MFR	Repeat sequence 14 for VPASS video outputs J-7, J-8, J-10, and J-11.
16	S:N	RBV*	Utilizing the data of sequences 12, 13, 14, and 15, calculate the peak-to-peak signal to rms noise ratio for each VPASS video output. Verify that the VPASS output S:N (dB) meets the test criteria of item 4, table 1-5.
17	S:N	RBV*	Disconnect the HP-3403A and remove the tee connector from the video output line. Verify that all video output interface connectors are restored to normal configuration.
18	QLM	RBV*	Reapply modulation to the test transmitter. Verify correct indication and sequencing of all VPASS front panel indicators. Verify correct operation of the Quick Look Monitor (QLM) and camera. A photograph of the QLM display should be made and retained for station records and future comparisons.
19	Frequency Response	RBV*	Set the TPG pattern selector for a horizontal burst (pattern 20) output. Connect the dual-channel oscilloscope to display the TPG output on channel A and the VPASS video output on channel B. Adjust the oscilloscope controls for equal amplitude of the horizontal sync edge (sync tip to white reference levels) of the A and B displays.
20	Frequency Response	RBV*	Compare the relative amplitudes of the channel A and channel B displays. The relative amplitudes of the channel A and B black reference, 50 kHz, 100 kHz, 200 kHz, 500 kHz, 1 MHz, 2 MHz, and 3.2 MHz should meet the test criteria of item 5, table 1-5.

* For ETC testing, the RBV operator is located at the ERTS OCC.

RBV FM Downlink Test (cont)

Seq	Test	Operator	Instructions
21	Frequency response	RBV*	Repeat sequences 19 and 20 for each VPASS video output (J-6, J-7, J-8, J-10, and J-11).
22	Frequency response	RBV*	Set the TPG pattern selector for a white level video test pattern (50) output. With the oscilloscope set up as given in sequence 19, verify that the white level tilt meets the test criteria of item 6, table 1-5.
23	Frequency response	RBV*	Repeat sequence 22 for each VPASS video output.
24	Linearity	RBV *	Set the TPG for a $\sqrt{2}$ grey scale test pattern (01) output. With the oscilloscope set up per sequence 19, verify that the linearity of the channel B display meets the test criteria of item 7, table 1-5.
24A	Linearity	RBV*	Repeat sequence 24 for each VPASS video output.
25	Record/ Repro-duce	RBV/TR-70*	Set up the TR-70 video tape recorder for normal RBV operation as specified in STDN No. 601/ERTS. Set up the oscilloscope to monitor the tape recorder input. Start the video tape recorder and record a 3-minute interval of the horizontal multiburst (pattern 20), a 3-minute interval of $\sqrt{2}$ grey scale (pattern 01), and a 3-minute interval of white level (Pattern 50). During the recording interval, monitor and record the amplitudes of all components of each test pattern for playback comparison.
26	Record/ Repro-duce	RBV/TR-70*	Set up the recorder for reproduce (playback) mode into the VPASS. Set up the oscilloscope to monitor the raw playback data into the VPASS. Set up the VPASS for playback operation. Start the VTR and play back the recorded data. Monitor and record the relative amplitudes of all components of each test pattern as measured on the oscilloscope. Verify correct operation and sequencing of all VPASS front panel indicators throughout tape play-back.

* For ETC testing, the RBV and RCDR operators are located at the ERTS OCC.

RBV FM Downlink Test (cont)

Seq	Test	Operator	Instructions
27	Record/ Repro- duce	RBV/TR-70 *	Compare the relative amplitudes of the individual components of the oscilloscope display as measured in sequences 25 and 26 and verify that the data meets the test criteria of item 8, table 1-5.
28	Record/ Repro- duce	RBV/TR-70 *	Repeat sequences 25, 26, and 27 for TR-70 CVR mode.
29	Timing	RBV *	Reset the VPASS to FM receiver input mode. Verify PLL acquisition and normal indication and sequencing of the front panel indicators.
30	Timing	RBV *	Connect a HP-5245L counter to VPASS J-19. Set up the counter for a time interval measurement. Set the time interval COM/REM/SEP switch to COM. Set the start count for a negative transition and stop count for a positive transition. Allow the counter to complete a time interval measurement. The measured interval should be 12.840 seconds (± 0.002 second). See figure 1-20.
31	Timing	RBV *	Reset the counter start count for a positive transition and stop count for a negative transition. Transport stop measured interval should be 12.160 seconds.
32	Timing	RBV *	Connect the time interval start input to VPASS J-19 and set start count for a positive transition. Set the time interval COM/REM/SEP switch to SEP. Connect the time interval stop input to VPASS J-24 and set stop count for a negative transition. Allow the counter to complete a time interval measurement. The measured time interval should be 14.620 seconds.
33	Timing	RBV *	Disconnect the time interval stop input from VPASS J-24 and connect to VPASS J-28. Allow the counter to complete a time interval measurement. The measured interval should be 14.620 seconds.

*For ETC testing, the RBV and RCDR operators are located at the ERTS OCC.

Seq	Test	Operator	Instructions
34	Timing	RBV *	Disconnect the time interval stop input from VPASS J-28 and connect to VPASS J-29. Allow the counter to complete a time interval measurement. The measured time interval should be 18.120 seconds.
35	Timing	RBV *	Disconnect the time interval stop input from VPASS J-29 and connect to VPASS J-30. Allow the counter to complete a time interval measurement. The measured time interval should be 21.620 seconds.
36	Timing	RBV *	Disconnect the time interval start input from VPASS J-19 and connect to VPASS J-28. Disconnect the time interval stop input from VPASS J-30 and connect to VPASS J-24. Set time interval start and stop for a negative transition. Allow the counter to complete a time interval measurement. The measured time interval should be 3.500 seconds.
37	Timing	RBV *	Disconnect the time interval stop input from VPASS J-24 and connect to VPASS J-26. Allow the counter to complete a time interval measurement. The measured time interval should be 3.420 seconds.
38	Timing	RBV *	Disconnect the time interval stop input from J-26. Set the time interval stop for a positive transition. Set the time interval COM/REM/SEP switch to COM. Allow the counter to complete a time interval measurement. The measured time interval should be 3.420 seconds.
39	Timing	RBV *	Disconnect the time interval start input from VPASS J-28 and connect to VPASS J-29. Allow the counter to complete a time interval measurement. The measured time interval should be 3.420 seconds.

*For ETC testing, the RBV operator is located at the ERTS OCC.

RBV FM Downlink Test (cont)

Seq	Test	Operator	Instructions
40	Timing	RBV *	Connect the time interval stop input to VPASS J-26. Set the time interval stop for a negative transition. Set the time interval COM/REM/SEP switch to SEP. Allow the counter to complete a time interval measurement. The measured time interval should be 3.420 seconds.
41	Timing	RBV *	Disconnect the time interval stop input from VPASS J-26 and connect to VPASS J-24. Allow the counter to complete a time interval measurement. The measured time interval should be 3.500 seconds.
42	Timing	RBV *	Disconnect the time interval start input from VPASS J-29 and connect to VPASS J-30. Disconnect the time interval stop input from VPASS J-24 and connect to VPASS J-26. Allow the counter to complete a time interval measurement. The measured time interval should be 3.420 seconds.
43	Timing	RBV *	Disconnect the time interval stop input from VPASS J-26. Set the time interval stop for a positive transition. Set the time interval COM/REM/SEP switch to COM. Allow the counter to complete a time interval measurement. The measured time interval should be 3.420 seconds.
44		USB/MFR/ RBV/RCDR *	Turn off all test equipment and restore all interface connections to normal configuration.

*For ETC testing, the RBV and RCDR operators are located at the ERTS OCC.

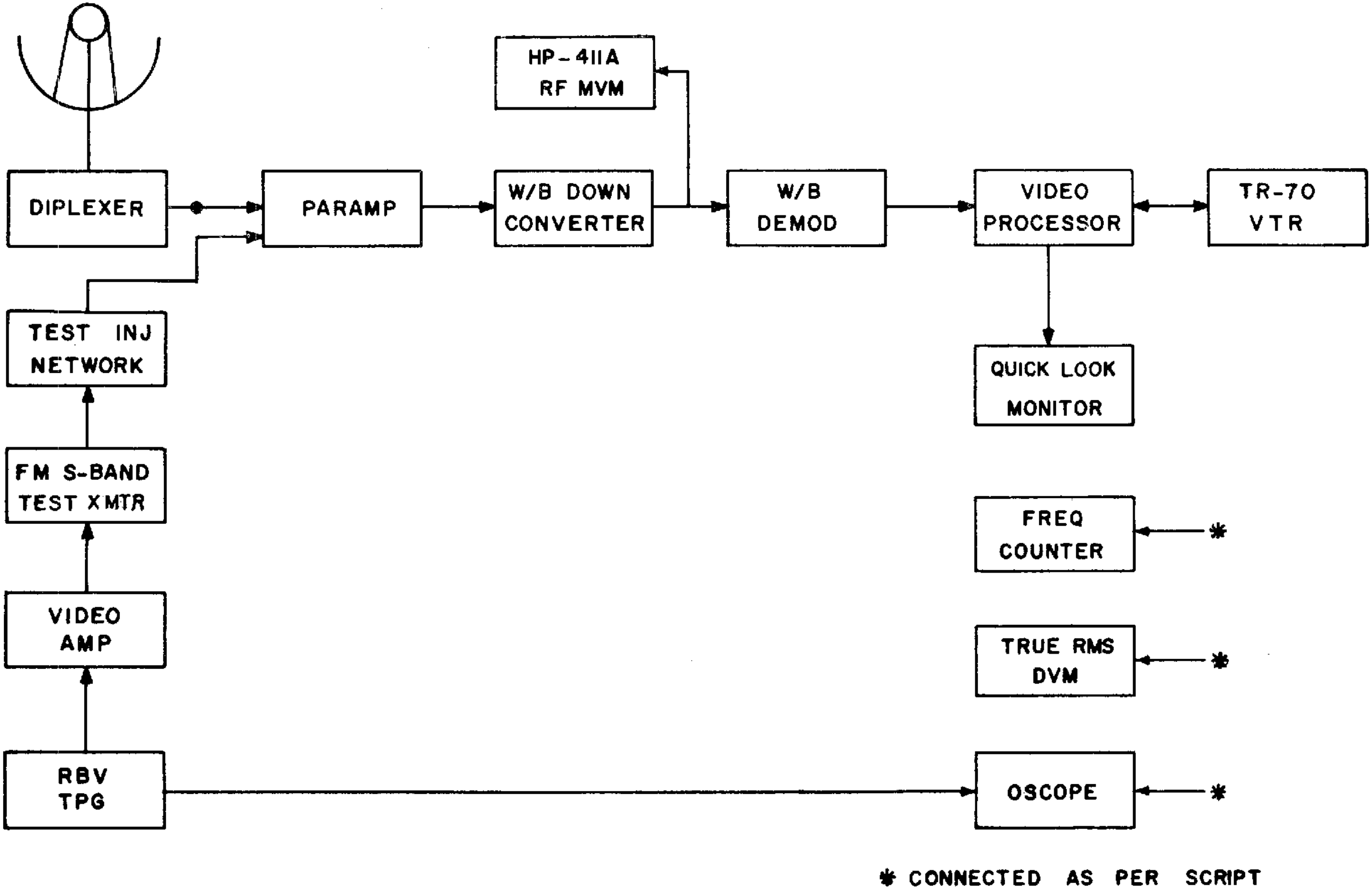


Figure 1-15. RBV Downlink Test Configuration (EGD)

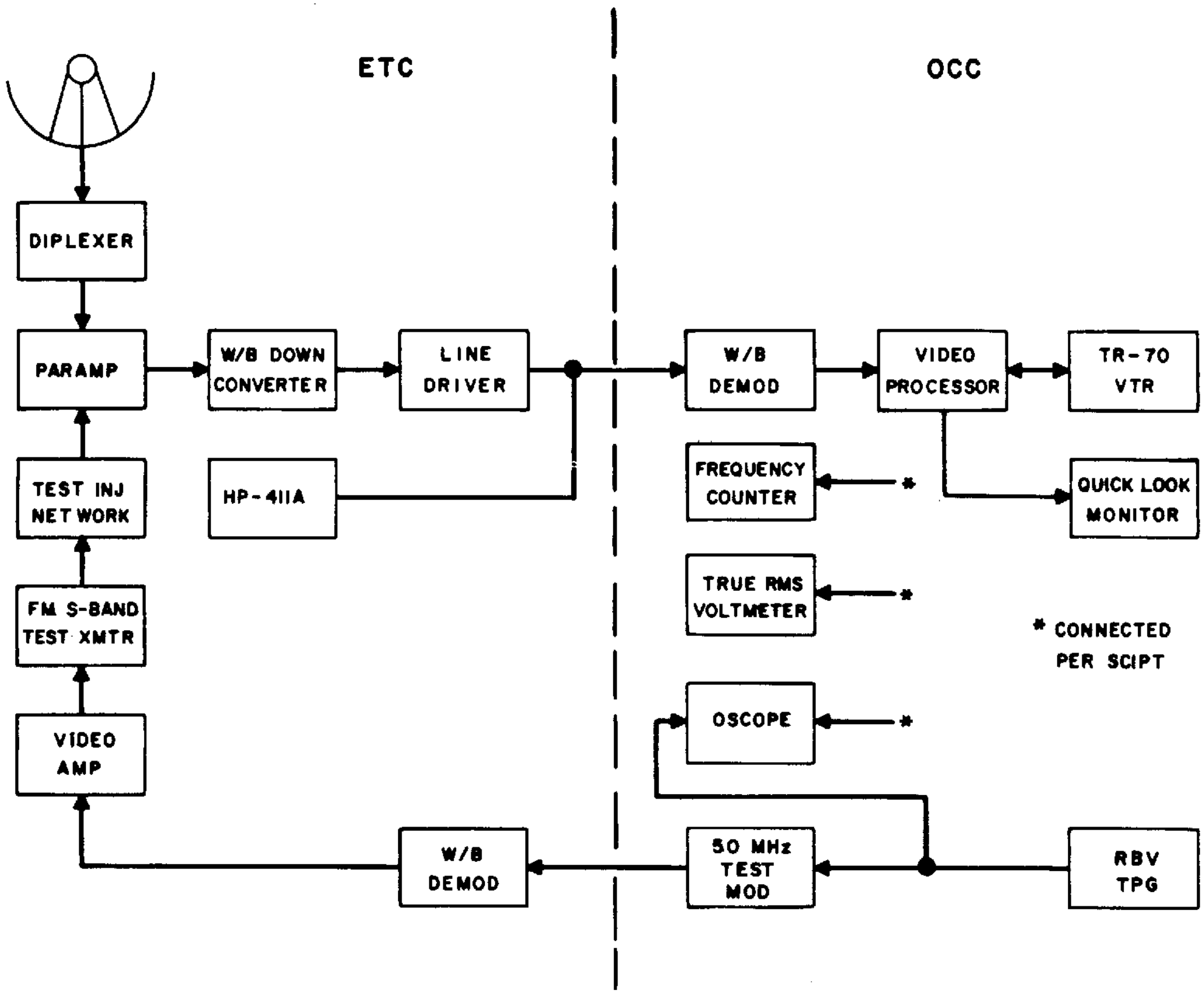


Figure 1-16. RBV Test Configuration (ETC/OCC)

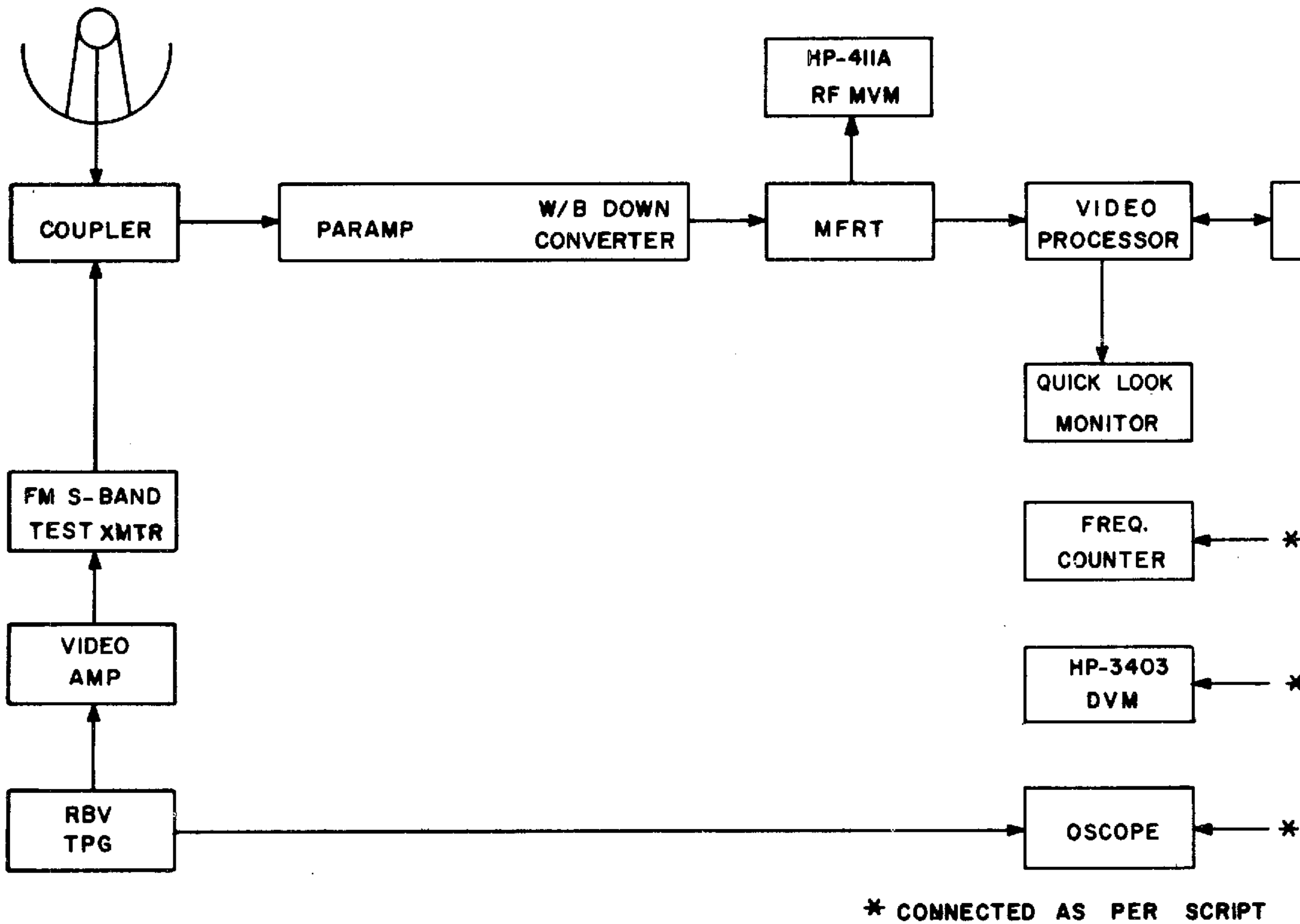


Figure 1-17. RBV Downlink Test Configuration (ULA)

Table 1-4. Equipment Test Parameters

Equipment	Control/Function	Indication/Setting
Test transmitter	FREQUENCY	2229.5 MHz
	DEVIATION	±5.6 MHz
USB wideband downconverter	FREQUENCY	2229.5 MHz
	IF BANDWIDTH	30.0 MHz
USB wideband demodulator *	IF BANDWIDTH	20. MHz
	MODE	LOCAL
Multifunction receiver	BAND SELECT	2200 - 2300 MHz
(Alaska only)	CHANNEL SELECT	429.5 MHz
	IF BANDWIDTH	20.0 MHz
	VIDEO BANDWIDTH	5.0 MHz
	DEMOD SELECT	FM
	TUNING MODE	OPEN LOOP
	TRACKING BANDWIDTH	300 Hz
	AGC SPEED	30 msec
VPASS*	INPUT SELECT	FM RECEIVER
	DISPLAY ENABLE/DISABLE	ENABLE
	DISPLAYED FRAME SEL	ENABLE 1, 2 & 3
	VERT SYNC MODE SEL	NORMAL
	ACQUISITION CYCLE	EACH FRAME
	Δ 0T ENABLE/DISABLE	ENABLE
	Δ 1 ENABLE/DISABLE	ENABLE
	Δ 3 ENABLE/DISABLE	ENABLE
	RE/ACQUISITION MODE	ENABLE
	HORIZ SYNC OUTPUT	PLL
	EARLY TRANSPORT RUN	AUTO

* For ETC testing, the noted Equipment is located at the ERTS OCC.

Table 1-4. Equipment Test Parameters (cont)

Equipment	Control/Function	Indication/Setting
TPG*	MODE SELECTION	NORMAL
	CYCLE	CONTINUOUS
	CAMERA No. 1	ON
	CAMERA No. 2	ON
	CAMERA No. 3	ON
	INT/EXT CLOCK	INT
	FILTER IN/OUT	IN
	PATTERN SELECT	As required
Link noise gens *	POWER	OFF

* For ETC testing, the noted equipment is located at the ERTS OCC.

Table 1-5. Test Criteria

Item	Parameter	Station			
		ULA	EGD	ETC	OCC
1	0 dB C:N ratio	-102.4 dBm	-102.9 dBm	-102.9 dBm	N/A
2	VPASS in/out	1.0 Vpp	1.0 Vpp	N/A	1.0 Vpp
	White reference level	1.0 V	1.0 V	N/A	1.0 V
	Black reference level	0.27 V	0.27 V	N/A	0.27 V
	Sync tip level	0.0 V	0.0 V	N/A	0.0 V
3	Demod S:N ratio	35 ±2 dB	35 ±2 dB	N/A	35 ±2 dB
4	VPASS output S:N ratio				
	Video out J-6	35 ±2 dB	35 ±2 dB	N/A	35 ±2 dB
	Video out J-7	35 ±2 dB	35 ±2 dB	N/A	35 ±2 dB
	Video out J-8	39 ±2 dB	41 ±2 dB	N/A	41 ±2 dB
	Video out J-10	39 ±2 dB	41 ±2 dB	N/A	41 ±2 dB
	Video out J-11	39 ±2 dB	41 ±2 dB	N/A	41 ±2 dB
5	VPASS frequency response				
	Video out J-6 Video out J-7 Video out J-8 Video out J-10 Video out J-11	Flat within 3 dB	Flat within 3 dB	N/A	Flat within 3 dB
6	White level tilt	5 mV/line	5 mV/line	N/A	5 mV/line
7	VPASS linearity	±3 %	±3 %	N/A	±3 %
8	TR-70 frequency response	±1.5 dB	±1.5 dB	N/A	±1.5 dB
	White level tilt	5 mV/line	5 mV/line	N/A	5 mV/line
	Linearity	±3 %	±3 %	N/A	±3 %

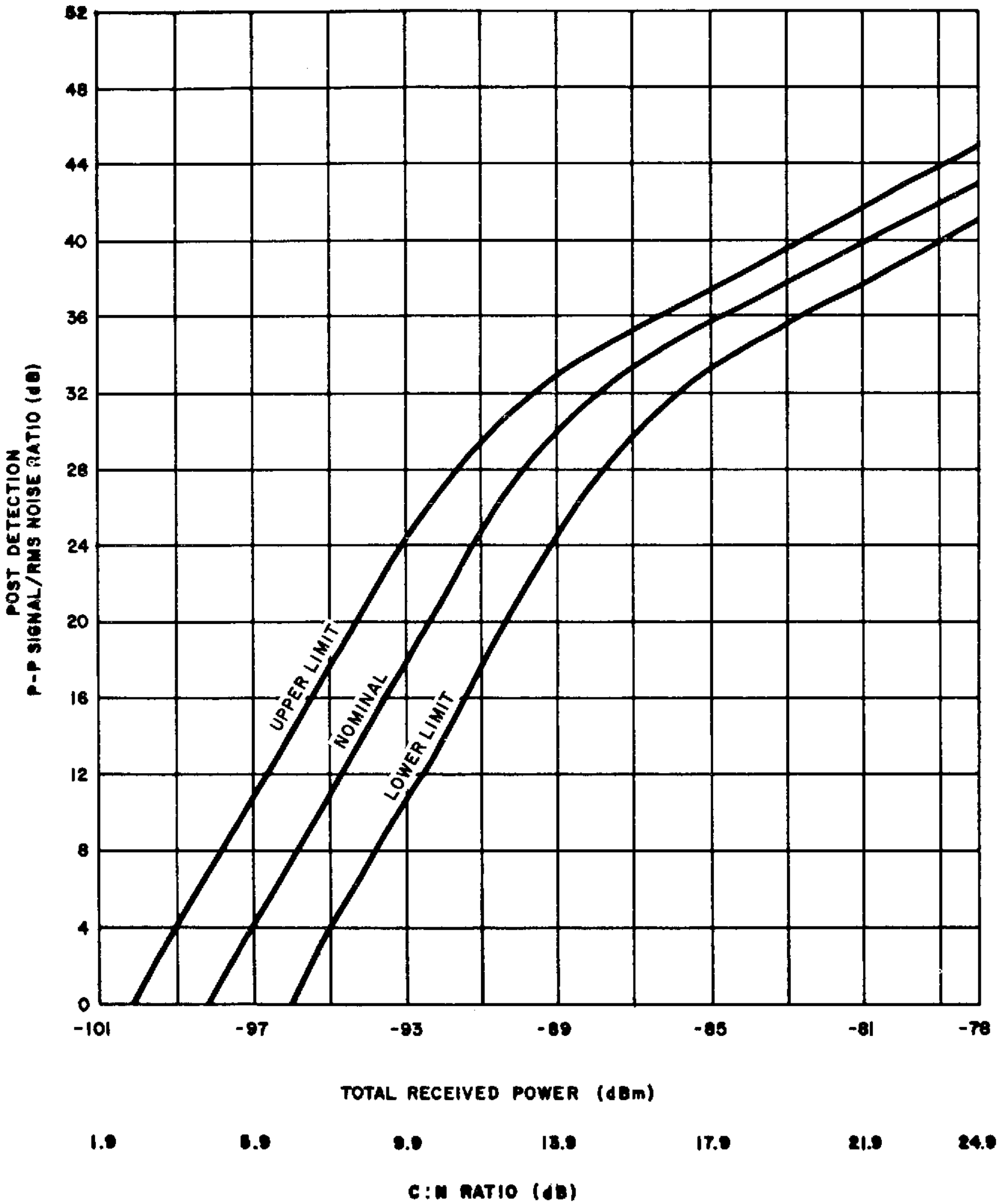


Figure 1-18. RBV Test Criteria (ETC and GDS)

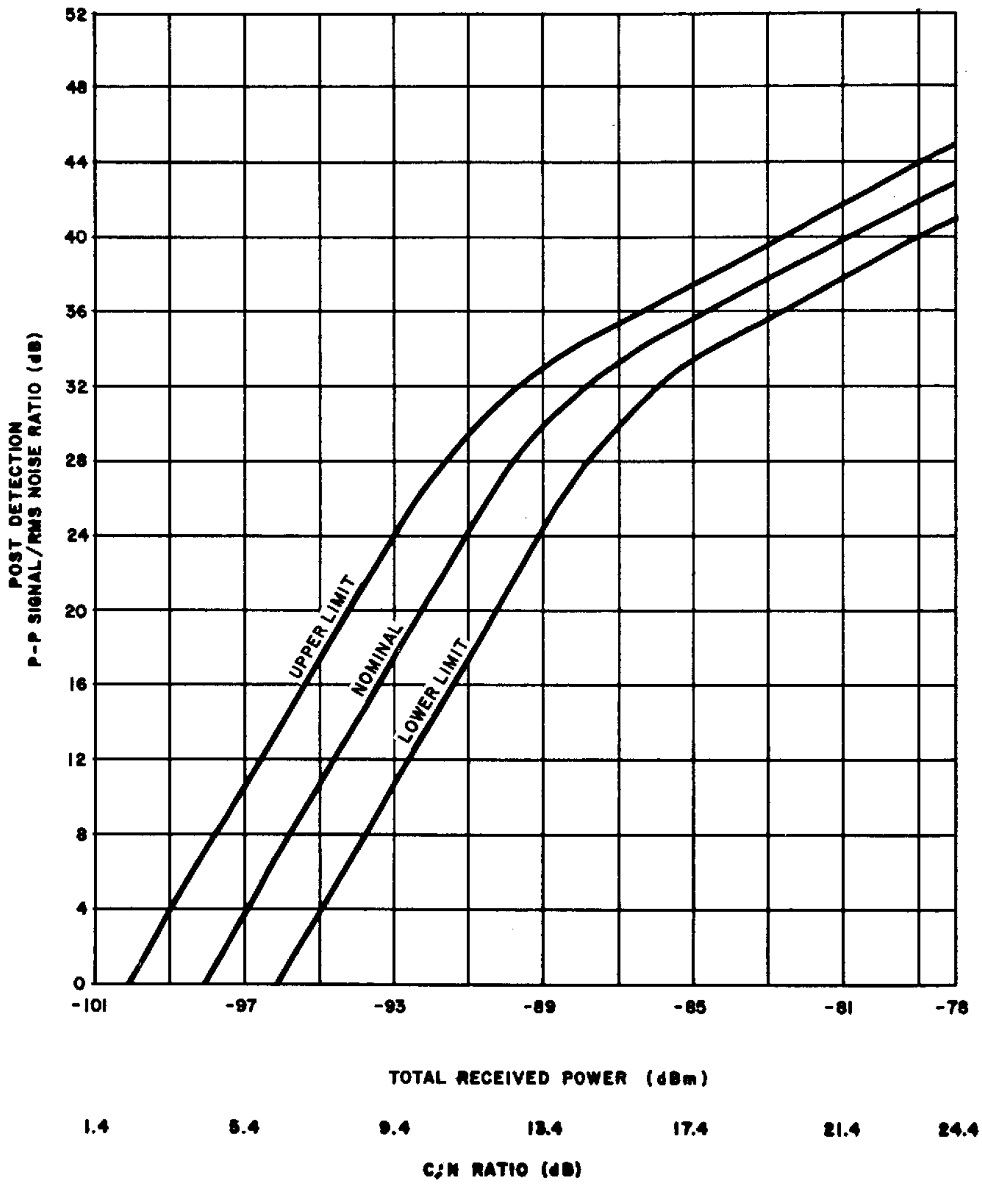


Figure 1-19. RBV Test Criteria (ULA)

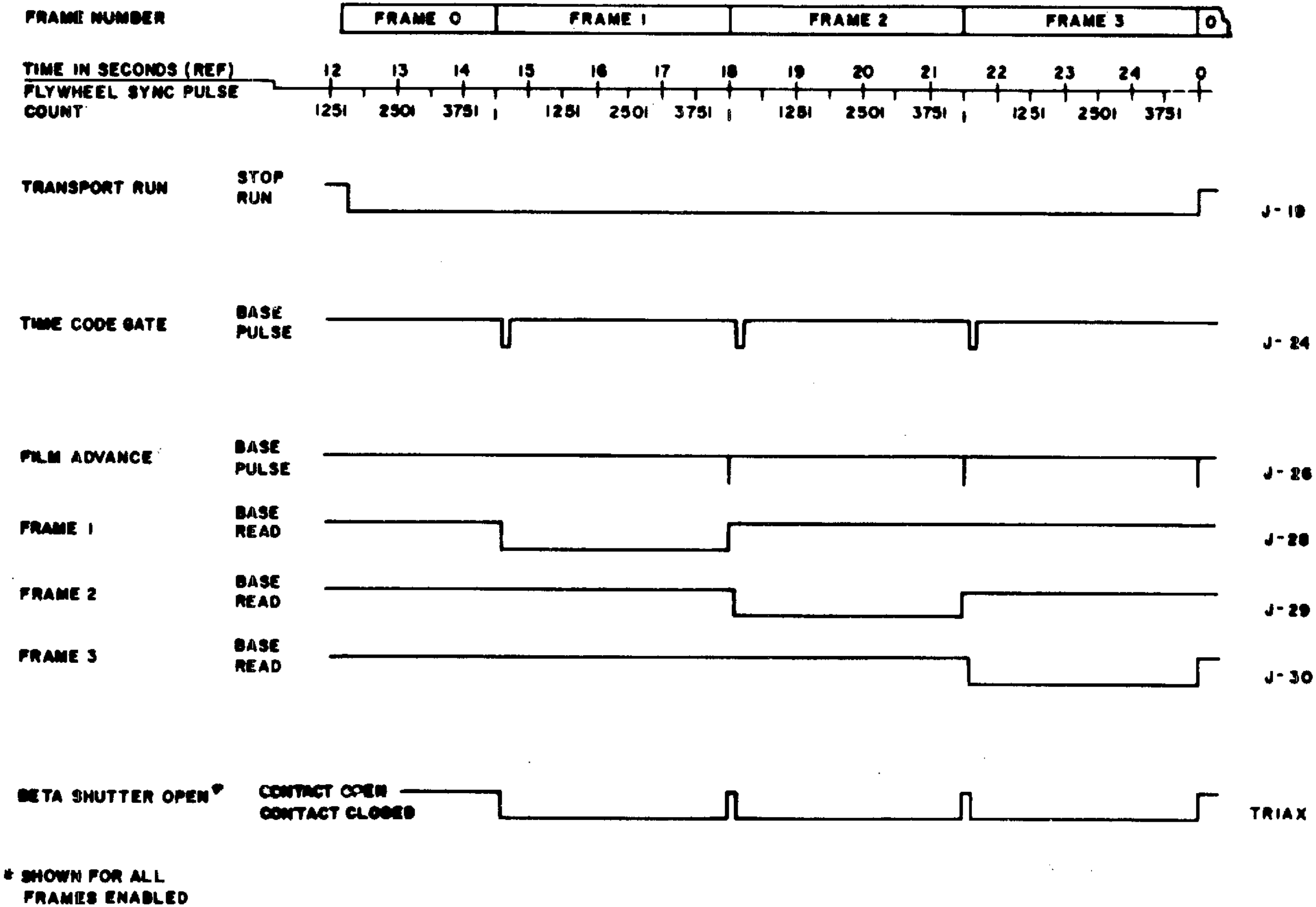


Figure 1-20. VPASS Timing

2.1 INTERCOMMUNICATIONS SYSTEM CONFIDENCE TEST

OBJECTIVE

The objective of the intercommunications system confidence test is to demonstrate the operational capability of the intercommunications system to support the Earth Resources Technology Satellite (ERTS) mission.

TEST DESCRIPTION

The test objective will be accomplished by exercising each mission-required operator position utilizing script developed by the Operations Supervisor (OPSR). The OPSR may use the stations' cross-connect or wire list as an aid in determining the list of operator positions.

TEST PROCEDURES

2.1.1 The Test Conductor (TC) will designate the coordination loop.

2.1.2 All mission operator stations must keep the TC coordination loop monitor key depressed during test.

2.1.3 The TC will perform a 1-to-5, 5-to-1 test count on the loop under test.

2.1.4 Check the operator positions individually for readability and signal strengths on all voice circuits.

2.1.5 As the loop test is performed, each operator station will:

a. Press monitor key.

b. Press (Talk/Listen) key of the loop being tested.

c. Check headset level control.

d. Release T/L key of the loop being tested.

e. Press T/L key of all other loops and monitors for cross talk.

f. Press T/L key of the loop being tested and respond to roll call.

2.1.6 The TC will conduct a status roll call on the loop under test. Positive reporting should be utilized. Upon failure to contact any operator station, the TC will establish contact on the designated coordination loop.

2.1.7 The TC will announce the next loop under test and repeat procedures given in paragraphs 2.1.1 through 2.1.6 for each mission-required loop.

2.1.8 Report circuit discrepancies to the TC for corrective action upon completion of test.

2.2 STRIPCHART, EVENT, AND MAGNETIC TAPE RECORDERS

OBJECTIVE

The objective of this test is to verify that all stripchart, event, and magnetic tape recorder channels utilized for mission support are functioning properly and are patched as specified in the Network Operations Support Plan for the Earth Resources Technology Satellite (ERTS), STDN No. 601/ERTS.

2.2.1 STRIPCHART RECORDERS

2.2.1.1 Verify that the manual simulator chart recorder calibration patch panel is installed in the MSFTP-2 simulator.

2.2.1.2 Verify that all mission required analog stripchart recorders are patched, and run at the proper speeds as specified in STDN No. 601/ERTS.

2.2.1.3 Verify calibration of all channels at 0 percent, midrange, and 100 percent as a minimum.

2.2.1.4 Briefly record the Digital-to-Analog Converter (DAC) outputs during the performance of the COST Pulse Code Modulation (PCM) subtest.

2.2.1.5 Verify the correct operation of all channels, and remove the test charts from recorders.

2.2.1.6 Make a final patching check and verify that sufficient chart paper is on the equipment to support the mission pass.

2.2.2 EVENT RECORDERS

2.2.2.1 Check event recorder chart speeds of 1, 2, 5, 10, 25, 50, and 125 mm/sec by pressing the appropriate pushbuttons.

2.2.2.2 Set the recorder chart speed to 10 mm/sec, and verify that the timing pens are operating correctly.

2.2.2.3 Verify that all writing pens engage with the chart paper and write.

2.2.2.4 Signals will become available at the event recorders during the data flow test and all channels will be verified.

2.2.3 MAGNETIC TAPE RECORDERS

2.2.3.1 Clean the heads on all mission required recorders and install scratch tapes.

2.2.3.2 Verify that the recorders are set to the proper recording speeds, calibrated, and that all recorder channels are patched as specified in STDN No. 601/ERTS.

2.2.3.3 The Recorder Tech will monitor each track for signals to be recorded during mission support. Signals will be generated throughout the Station Readiness Test (SRT).

Note

> The recorder tech may, prior to the start of the SRT, confer with the various Test Conductors (TC's) if he requires information concerning the sequence and scheduling of particular signals during the SRT.

2.2.3.4 When the Recorder Tech observes the presence of signals on various channels, he should start the recorder (s). Record these signals and monitor the playback head for proper reproduction. Continue this process until all mission-required channels are checked.

2.2.4 RELOADING AND ANNOTATING

2.2.4.1 Upon completion of the SRT, reload tape drives and paper recorders with new tapes and charts to support the mission.

2.2.4.2 Make final patching check, since some mission patches may have been removed to support the SRT.

2.2.4.3 Annotate all tapes and chart recordings as specified in STDN No. 601/ERTS. Calibrate all paper chart recorders and record test signals on the magnetic tape recorders as specified in STDN No. 601/ERTS.

2.2.5 TR-70 VIDEO TAPE PRERECORDING SETUP

Before each series of consecutive passes, perform a prerecording setup as follows:

2.2.5.1 Clean head wheel and tape transport.

2.2.5.2 Calibrate the CRO waveform monitor.

2.2.5.3 Feed self-test sweep signal to recorder.

2.2.5.4 Check input level to modulator.

2.2.5.5 Check the vacuum and pressure gauges. In STANDBY mode, the gauges should read:

Control	Setting
VACUUM GAUGE	35
LOW PRESSURE AIR GAUGE	30 lb/sq in.
HIGH PRESSURE GAUGE	55 lb/sq in.

2.2.5.6 Check the vacuum guide position and pole-tip by playing back the RCA alignment tape.

Note

Do not place the recorder in the SETUP or MASTER RECORD modes while an alignment tape is on the transport.

2.2.5.7 Play a standard alignment tape, adjust output level, and remove after adjustment.

2.2.5.8 Place the electronics in a back-to-back condition, adjust the carrier frequencies, and set the deviation.

2.2.5.9 Load a freshly degaussed test tape on the transport and go into the SETUP mode. The GUIDE indicator should light.

2.2.5.10 Check the servos on the CRO monitor.

2.2.5.11 Press each of the pushbuttons, in turn, on the MULTIMETER selector panel and check for proper multimeter readings.

2.2.5.12 On the STANDARD SELECT panel, select FULL TRK, RBV, and LOCAL modes.

2.2.5.13 On the CRO selector, check the CT REC for a 312.5-Hz sine wave and the REF for a 312.5-Hz square wave.

2.2.5.14 On the PICTURE MONITOR SELECTOR press the TW PULSE and observe the dots. They should be locked with less than 1/4-inch of motion.

2.2.5.15 Take the recorder out of SETUP and set the tape timer to 0.

2.2.5.16 Place the recorder in MASTER RECORD and record about 2 minutes of 100-kHz and BURST-A data from the self-test generator.

2.2.5.17 Rewind the tape to 0 on the tape timer and place the recorder in the PLAY mode.

2.2.5.18 Observe FM level on the CRO monitor and adjust CT phase for a maximum peak-to-peak signal.

2.2.5.19 Observe the video out on the oscilloscope. Sync oscilloscope to XTAL 20 kHz. Select EVDL on the display panel and observe the 100-kHz signal.

2.2.5.20 Adjust the reference phase control on module 628 for about 100 msec spread on 100 kHz. Ajust PT 01 and 3 for coincidence. Adjust PT 02 and 4 for coincidence. Adjust reference phase 2-4 for all four coincidences.

2.2.5.21 Check TBS ERROR for minimum, EVDL 1-3 and 2-4 ERRORS for minimum, and EVDL meter 1-3 and 2-4 ERRORS for about 4V each.

2.2.5.22 Check EQ OUT on CRO monitor for good fades.

2.2.5.23 Play back the BURST-A data and set equalizers so playback looks flat or like Electronic-to-Electronic (E-E).

2.2.5.24 Rewind the test tape and remove from recorder.

2.3 METRIC DATA TESTS

There are three different metric data tests:

a. Unified S-band Metric Data Test.

b. Alaska (ULA) and VHF B/U Metric Data Test.

c. Minitrack Interferometer.

2.3.1 UNIFIED S-BAND METRIC DATA TEST

OBJECTIVES

The objectives of the Unified S-band (USB) Metric Data test are to verify that the data outputs of the Tracking Data Processor (TDP) are correct in identification, range, and angles; that the antenna will autotrack and reacquire the boresight tower; and that the Antenna Position Programmer (APP)/1218 interface using 29-point acquisition messages or internet predicts will drive the antenna properly.

TEST DESCRIPTION

The test objective is accomplished by acquiring and autotracking the collimation signal source, two-way ranging, and Doppler on collimation signal source; and by driving the antenna using sample drive tapes.

PREREQUISITES

The following prerequisites must be completed before testing can begin:

a. Equipment is set up as shown in figure 2-1.

b. Verify that the receiver angle channels have been properly balanced, aligned, and phased on the mission tracking frequency and alternate frequency.

c. The phase shifter and attenuator settings have been recorded.

d. The collimation tower boresight transmitter is on and operating at the downlink frequency.

e. All error channel isoamps are zeroed.

f. The Ground Communications Coordinator (GCC) has provided the punched tape of the acquisition message for the Station Readiness Test (SRT) to the 1218 computer operator (see figure 2-2).

Note

> At the completion of USB Metric Test using RAPID, the 1218 operator will load the software designated in STDN No. 601/ERTS to operationally support the acquisition of ERTS SC. Utilizing the mission acquisition software, verify 1218/APP will point the USB antenna to any convenient preselected angles. At this time ensure that all equipment is configured for mission support.

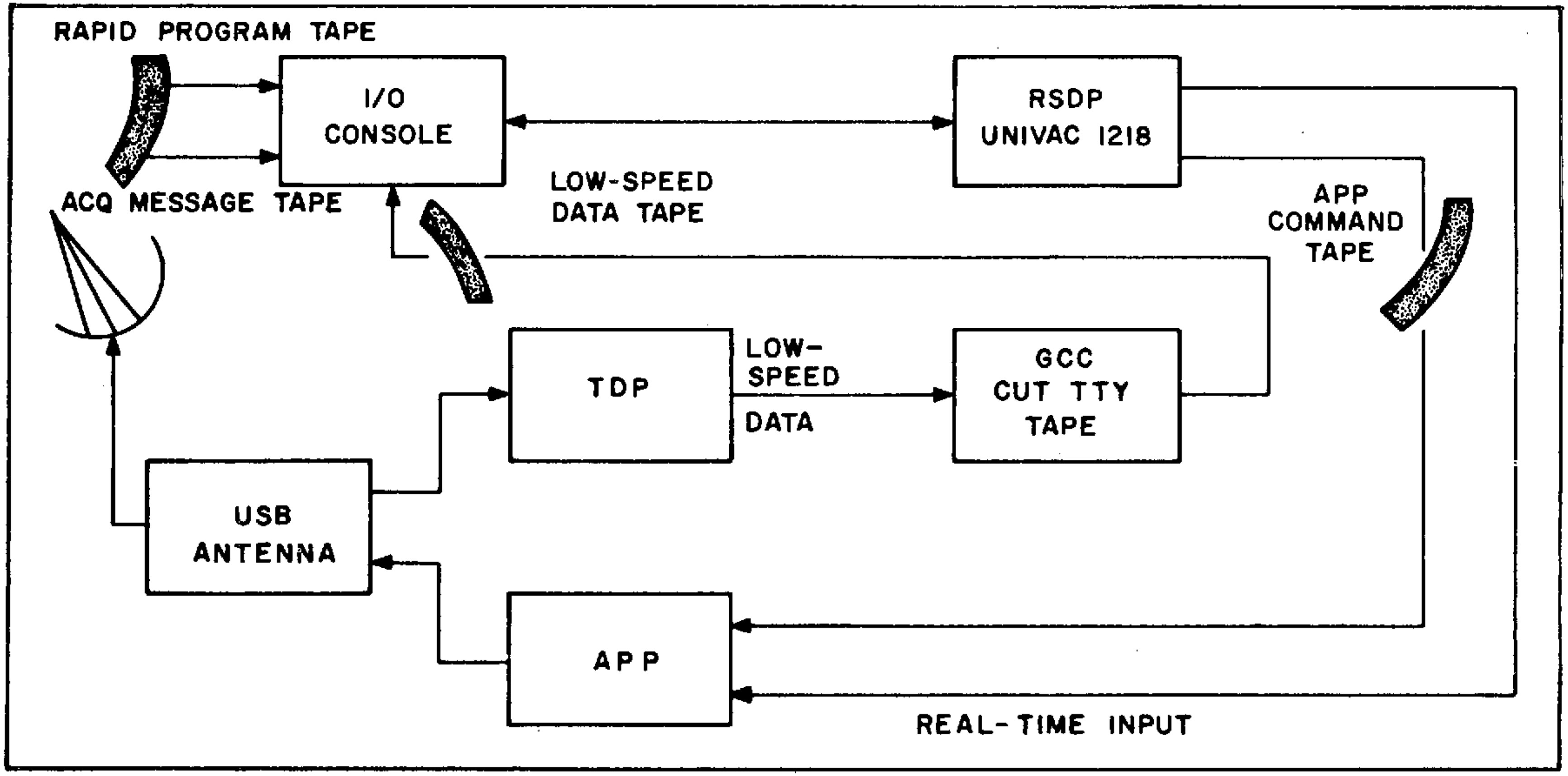


Figure 2-1. Preliminary Equipment Setup

```
   CR,  LF,  LF
   CR,  LF,  LET,  FIG,  FIG
*  0010    CR,  CR,  LF,  FIG
*  00000000 CR,  CR,  LF,  FIG
*  00000440 CR,  CR,  LF,  FIG
   S 7000      S 7000      S 34 CR,  CR,  LF,  FIG
   S 6500      S 6500      S 42
   S 6000      S 6000      S 32
   S 5500      S 5500      S 40
   S 5000      S 5000      S 30
   S 4500      S 4500      S 38
   S 4000      S 4000      S 28
   S 3500      S 3500      S 36
   S 3000      S 3000      S 26
   S 2500      S 2500      S 34
   S 2000      S 2000      S 24
   S 1500      S 1500      S 32
   S 1000      S 1000      S 22
   S 0500      S 0500      S 30
   S 0000      S 0000      S 20
     -0500       -0500     S 32
     -1000       -1000     S 24
     -1500       -1500     S 34
     -2000       -2000     S 26
     -2500       -2500     S 36
     -3000       -3000     S 28
     -3500       -3500     S 38
     -4000       -4000     S 30
     -4500       -4500     S 40
     -5000       -5000     S 32
     -5500       -5500     S 42
     -6000       -6000     S 34
     -6500       -6500     S 44 CR,  CR,  LF,  FIG
     -7000       -7000     S 36 CR,  FIG,  CR,  FIG
```

Note

S = space, CR = carriage return, LF = line feed,
FIG = figure shift. LET = letter shift.

Figure 2-2. Sample Acquisition Message for SRT

Seq	Test	Operator	Instructions
1			Tracking Data Processor Preliminary Test Note To perform metric data and CMD tests in parallel, lock receiver/exciter to boresight transponder prior to modulating the carrier.
1.1	Prelim	TDP	Set the TDP controls as indicated: <u>Control</u> — <u>Setting</u> DATA — INTERNAL TEST 1 TTY FRAME RATE — 1P6S DISPLAY RATE — 1PPS DATA CONDITION — GOOD CONTROL MODE — LOCAL MODEM FRAME RATE — MANUAL HIGH SPEED DATA START/STOP — START LOW SPEED DATA START/STOP — START COMMUNICATION HEADING — NORMAL <u>TDP Data Patch Panel</u> — <u>Setting</u> HIGH SPEED CODE WORD — 33 BIT Note Verify that the LOW SPEED RECORD/PLAYBACK switch is in the RECORD position. This switch is located in the tape punch drawer.

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
1.2	Prelim	Servo	Set the APP REAL ANGLE DISPLAY RATE switch on the APP remote control panel to 1 PPS.
1.3		TDP	The following data should print on the TTY page printer: (INTERNAL TEST 1) XX00000.000000000.000000.0------------------------0 (25 ea) Note The first two characters (XX) will vary according to station ID.
1.4		TDP	Verify that the correct ID is printed.
1.5		TDP	Momentarily press the MODEM FRAME RATE MANUAL INITIATE pushbutton.
1.6		TDP	Verify the following EDCG light pattern: EDCG at 33 1 2 4 5 10 12 14 15 16 17 18 20 22 23 25 27 30 31
1.7		TDP	Set the local control panel DATA switch to INTERNAL TEST 2. The following data should print on the TTY page printer: (INTERNAL TEST 2) XX70777-3((3(7(7(-777777-777777-7-----------------7 (25 ea). Momentarily press the MODEM FRAME RATE MANUAL INITIATE pushbutton. Verify the following EDCG light pattern: EDCG at 33 2 3 5 7 9 10 13 14 16 17 18 21 24 26 28 30 32
1.8		TDP	Press the high- and low-speed STOP pushbuttons.

Seq	Test	Operator	Instructions
2.			Antenna tests.
2.1			30-Foot Station Main Antenna (PM Autotrack)
2.1.1	Phas-ing	Servo	Actuate the PM/FM PBI on the isoamp control panel to indicate PM. Position the antenna to the normal collimation tower RF boresight. Lock receiver 1 to the bore-sight transmitter output and adjust the transmitter output for a received signal of -100 dBm. Record main RF boresight coordinates.
2.1.2		Servo	Disable the Y-axis. Manually position the antenna off the normal RF boresight in a positive direction in the X-axis 0.2 deg space angle. The X-axis error output as indicated by the rack-mounted servo amplifier VTVM should be -2V ±0.2 V. The X axis meter on the servo console error monitor and slave selector panel should indicate -0.2 deg in the AUTO TRK position.
2.1.3		Servo	Reposition the X-axis in a negative direction 0.2 deg space angle off the normal RF boresight. The VTVM should read approximately +2 V and the meter should read approximately +0.2 degree.
2.1.4		Servo	Press the AUTO TRK pushbutton on the servo console. The antenna should drive to the RF boresight and should be within ±0.018 deg of the normal boresight.
2.1.5		Servo	Disable the X axis, enable the Y-axis, and repeat sequences 2.1.2 through 2.1.4 of this section using 0.2 deg real angle.
2.2			30-Foot Station Acquisition Antenna
2.2.1	Phas-ing	Servo	Lock receiver 2 to the boresight transmitter output and adjust the transmitter output for a received signal of -100 dBm. Record acquisition RF boresight coordinates.

C-2

USB M[illegible]ic Data Test (cont)

Seq	Test	Operator	Instructions
2.2.2	Phas-ing	Servo	Disable the Y-axis. Manually position the antenna off the normal RF boresight in a positive direction in the X-axis 2 deg* space angle. The X-axis error output as indicated by the rack-mounted servo amplifier VTVM should be -2 V* ±0.2 V. The X-axis meter on the servo console error monitor and slave selector panel should indicate -2 deg* in the ACQ TRK position.
2.2.3		Servo	Reposition the X-axis in the negative direction 2 deg* space angle off the normal RF boresight. The VTVM should read approximately +2 V* and the meter should read approximately +2 deg*.
2.2.4		Servo	Press the ACQ TRK pushbutton on the servo console. The antenna should drive to the RF boresight.
2.2.5		Servo	Disable the X-axis, enable the Y-axis, and repeat sequences 2.2.2 through 2.2.4 of this section using 2 deg* real angle.
2.3			30 Foot Station Main Antenna (FM Autotrack)
2.3.1	Phas-ing	Servo/USB	Disable the X and Y axes. Actuate the PM/FM PBI on the isoamp control panel to indicate FM. Set the FM tracking receiver IF BANDWIDTH switch to WIDEBAND.
2.3.2		Coll/USB/ Servo	Set the Coll test transmitter to the Mission frequency and adjust the output for a -100 dBm received signal level.

*May be 1 or 2, depending on specific station capability.

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
2.3.3	Phas-ing	Coll/USB/Servo	Verify acquisition of the test transmitter using SIGNAL ACQ meter on the FM cross-correlation receiver.
2.3.4		Servo	Disable the Y-axis. Manually position the antenna off the normal RF boresight in a positive direction in the X-axis 0.2 deg space angle. The X-axis error output as indicated by the rack-mounted servo amplifier VTVM should be -2V ±0.2 V. The X axis meter on the servo console error monitor and slave selector panel should indicate -0.2 deg in the AUTO TRK position.
2.3.5		Servo	Reposition the X-axis in a negative direction 0.2 deg space angle off the normal RF boresight. The VTVM should read approximately +2 V and the meter should read approximately +0.2 degree.
2.3.6		Servo	Press the FM TRK pushbutton on the servo console. The antenna should drive to the RF boresight and should be within ±0.018 deg of the normal boresight.
2.3.7		Servo	Disable the X axis, enable the Y-axis, and repeat sequences 2.3.4 through 2.3.6 of this paragraph using 0.2 deg real angle.
2.4			85-foot Main Antenna (PM AUTOTRACK)
2.4.1	Phas-ing	Servo	Actuate the PM/FM PBI on the ISOAMP control panel to indicate PM. Position the antenna to the normal collimation tower RF boresight. Lock receiver 1 to the boresight transmitter output and adjust the transmitter output for a received signal of -100 dBm. Record main RF boresight coordinates.

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
2.4.2		Servo	Disable the Y-axis. Manually position the antenna off the normal RF boresight in a positive direction in the X-axis 0.1-deg space angle. The X-axis error output as indicated by the rack-mounted servo amplifier VTVM should be -1 V ±0.1 V. The X-axis meter on the servo console monitor and slave selector panel should indicate -0.1 deg in the AUTO TRK position.
2.4.3	Phasing	Servo	Reposition the X-axis in a negative direction 0.1-deg space angle off the normal RF boresight. The VTVM should read approximately +1 V and the meter should read approximately +0.1 deg.
2.4.4		Servo	Press the AUTO TRK pushbutton on the servo console. The antenna should drive to the RF boresight and should be within ±0.018 deg of the normal boresight.
2.4.5		Servo	Disable the X-axis, enable the Y-axis, and repeat sequences 2.3.2 through 2.3.4 of this paragraph using 0.1-deg real angle.
2.5			85-foot Station Acquisition Antenna
2.5.1	Phasing	Servo	Lock Receiver No. 2 to the boresight transmitter output and adjust the transmitter output for a received signal of -100 dBm. Record acquisition RF boresight coordinates.
2.5.2		Servo	Disable the Y-axis. Manually position the antenna off the normal RF boresight in a positive direction in the X-axis 1-deg* space angle. The X-axis error output as indicated by the rack-mounted servo amplifier VTVM should be -1V* ±0.1V. The X-axis meter on the servo console error monitor and slave selector panel should indicate -1 deg* in the ACQ TRK position.

*May be 1 or 2, depending on specific station capability.

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
2.5.3		Servo	Reposition the X-axis in the negative direction 1-deg* space angle off the normal RF boresight. The VTVM should read approximately +1V* and the meter should read approximately +1 deg*.
2.5.4		Servo	Press the ACQ TRK pushbutton on the servo console. The antenna should drive to the RF boresight.
2.5.5		Servo	Disable the X-axis, enable the Y-axis, and repeat sequences 2.4.2 through 2.4.4 of this paragraph using 1-deg* real angle.
2.6			85-foot Station Main Antenna (FM Autotrack)
2.6.1	Phasing	Servo/USB	Disable the X and Y axes. Actuate the PM/FM PBI on the isoamp control panel to indicate FM. Set the FM tracking receiver IF BANDWIDTH switch to WIDEBAND.
2.6.2		COLL/USB/ Servo	Set the Coll test transmitter to the mission frequency and adjust the output for a -110 dBm received signal level.
2.6.3		COLL/USB/ Servo	Verify acquisition of the test transmitter using SIGNAL ACQ meter on the FM tracking receiver.
2.6.4		Servo	Disable the Y-axiz. Manually position the antenna off the normal RF boresight in a positive direction in the X-axis 0.1 deg space angle. The X-axis error output as indicated by the rack-mounted servo amplifier VTVM should be -1 V ±0.1 V. The X-axis meter on the servo console monitor and slave selector panel should indicate -0.1 deg in the AUTO TRK position.
2.6.5		Servo	Reposition the X-axis in a negative direction 0.1 deg space angle off the normal RF boresight. The VTVM should read approximately +0.1 deg.
2.6.6		Servo	Press the FM TRK pushbutton on the servo console. The antenna should drive to the RF boresight and should be within ±0.018 deg of the normal boresight.
2.6.7		Servo	Disable the X-axis, enable the Y-axis, and repeat sequences 2.6.4 through 2.6.6 of this this section using 0.1 deg real angle.

*May 1 or 2, depending on specific station capability.

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
3			RAPID LOADING
3.1	RAPID	1218	Mount the RAPID program tape on the I/O console.
3.2		1218	Set the SYNC ON/OFF switch to ON.
3.3		1218	Set the INT/EXT switch to INT.
3.4		1218	Verify all STOP and SKIP keys are down.
3.5		1218	Press the LOAD PBI and start the computer.
3.6		1218	After a good program load, initialize at 10,000 and start the computer.
4			PROCESSING THE ACQUISITION MESSAGE
4.1	ACQ MSG	1218	Mount the sample acquisition message on the I/O reader with the 3- level toward the reader.
4.2		1218	Note In the test procedure when the computer operator is instructed to "type in" he must press the INTERRUPT PBI on the I/O console, press CARRIAGE RETURN (CR), then type the mnemonic. When the operator is instructed to "type" he need only type the information requested in answer to a computer-generated query. Type in: ACR ↑
4.3		1218	If the computer prints out: STA, Type your station Code and ↑ The computer will read in the acquisition message and the I/O will print out: PRI ACQ 29 PT AOS IS XXYYZZ.

Seq	Test	Operator	Instructions
5			APP DRIVE TAPE GENERATION (Optional)
5.1	APP TAPE	1218	Set SKIP key 0 up to suppress TTY. Ensure that all other SKIP and STOP keys are down.
5.2		1218	Type in one of the following to generate a drive tape for your station: XYA ↑ (for XY APP tape) I/O console will print out: OPR,
5.3		1218	Type: 001 ↑ (for 1 point per second rate) APP drive tape will be punched. Note Set SKIP key ∅ ON, if TTY Printout is not desired.
6			REAL TIME ANTENNA DRIVE
6.1	REAL TIME	1218	As soon as the tape generation is complete, type in: PR1 ↑
6.2		1218	Set SKIP key 3 UP if EI-4317 <u>is not</u> installed.
6.3		APP	Set the APP for real-time computer drive. Note Set NEW PROGRAM ON/OFF switch to ON if EI-4317 <u>is</u> installed.

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
6.4		SERVO	Manually position the antenna to +70 degrees in X and Y angle.
6.5		APP/TDP/ SERVO/1218	Coordinate to verify that all positions are ready to perform test.
6.6		APP	Press READ ONE WORD PBI to obtain three points of data.
6.7		APP	Set current time plus approximately 1 minute into the ADD TIME HOURS and MINUTES digit switches. Set SECONDS digit switches to 00.
6.8		APP	Press the ADD TIME PBI.
6.9		APP	Press the START SEARCH PBI.
6.10		SERVO	Press the PROG/READY PBI. Set the BANDWIDTH control to 1.
6.11		TDP	Set COMMUNICATIONS HEADING switch to JJ. Set DATA switch to REAL. Set TTY FRAME RATE switch to 1 P6S. Press the LOW SPEED DATA START/STOP PBI to START.
6.12		TDP	Notify GCC that the TDP L/S output should be monitored and a tape should be punched. Note GCC will monitor the TDP low-speed output teletype and punch a tape of the data. This tape will be immediately supplied to the 1218 computer operator. At some stations, the 1218 computer will have its own TTY. In this case, GCC will notify the computer operator that the TDP L/S data is patched.

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
6.13		APP/TDP/ SERVO/1218	When real time advances to the time inserted into the digit switches, the antenna should move through a simulated pass.
6.14		TDP	While the antenna is moving through the pass, set the TDP PBI's as indicated and verify that TTY character 7 (5th printed character) indicates correctly: Data Condition — Data — Character 7 BAD — REAL — 4 BAD — TEST — 0 GOOD — TEST — 1 GOOD — REAL — 5
6.15		SERVO	During the pass, monitor the COMMAND ANGLE readout and SERVO ERROR indicators for proper operation.
6.16		TDP	At the end of the pass, press the LOW SPEED DATA START/STOP PBI to STOP, and check TTY printout for JJ header.
6. 17		APP	At the end of the pass, press STOP READER PBI.
6.18		GCC	Deliver the TDP L/S TTY tape to the 1218 operator.
7			TAPE DRIVE TEST
7.1	TAPE DRIVE	APP	Set the APP local and/or remote control panel switches as follows: Control — Setting a. REAL ANGLE SOURCE — ENCODER b. COMMAND DATA SOURCE — TAPE c. CONTROL MODE — LOCAL

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
7.1 (cont)			d. PROGRAM CONTROL switches (1) AUTO/PROGRAM — PROGRAM (2) ADD ERROR — Not lit (3) STORE ERROR — Not lit (4) OFFSET ANGLES — Not lit (5) ADD TIME — Not lit e. TAPE CONTROL — STOP READER
7.2		SERVO	Manually position the antenna to +70 degrees in X and Y angle.
7.3		TDP/APP/ SERVO	Coordinate to verify that all positions are ready to perform the test.
7.4		APP	Press READ ONE WORD PBI to obtain three points of data from APP tape.
7.5		APP	Set current time plus approximately 1 minute into the ADD TIME HOURS and MINUTES digit switches. Set SECONDS digit switches to 00.
7.6		APP	Press the ADD TIME PBI.
7.7		APP	Press the START SEARCH PBI.
7.8		SERVO	Press the PROG/READY PBI. Set the BANDWIDTH control to 1.
7.9		TDP	Set the DATA switch to REAL. Set the TTY FRAME RATE switch to 1P6S. Press the LOW SPEED DATA START/STOP PBI to START.
7.10		TDP	Notify GCC that the TDP L/S output should be monitored and a tape should be punched. Note GCC will monitor the TDP low-speed output teletype and punch a tape of the data. This tape will immediately

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
7.10		(continued)	be supplied to the 1218 computer operator. At some stations, the 1218 computer will have its own TTY. In this case, GCC will alert the computer operator that the TDP data is patched.
7.11		APP/TDP/ SERVO	When real time advances to the time inserted into the digit switches, the antenna should move through a simulated pass.
7.12		TDP	While the antenna is moving through the pass, set the TDP PBI's as indicated and verify that TTY character 7 (5th printed character) indicates correctly: Data Condition / Data / Character 7 BAD / REAL / 4 BAD / TEST / 0 GOOD / TEST / 1 GOOD / REAL / 5
7.13		SERVO	During the pass, monitor the COMMAND ANGLE readout and SERVO ERROR indicators for proper operation.
7.14		TDP	At the end of the pass, press the LOW SPEED DATA START/STOP PBI to STOP. Set COMMUNICATION HEADING switch to NORMAL.
7.15		APP	At the end of the pass, press STOP READER PBI.
7.16		GCC	Deliver the TDP TTY tape to the 1218 operator.
8			DIFFERENCE/COMPARE CHECK
8.1		1218	Mount the TDP output tape on the I/O console reader with the 3-level side toward the reader. Set SKIP key 0 down.

Seq	Test	Operator	Instructions
8.2		1218	Type in: TDP ↑ Computer will print out: TOF,
8.3		1218	Type the APP time offset in hours, minutes, and seconds and ↑ Computer will print out: X/H,
8.4		1218	Type the APP X-angle offset in: sign and degrees in thousandths and ↑ Computer will print out: Y/D,
8.5		1218	Type the APP Y-angle offset in: sign and degrees in thousandths and ↑ The computer will read in the TDP tape, calculate differences, and the difference listing will be printed on the TTY.
8.6		1218/APP	Load the computer with the antenna drive program that will be used for operational support, and verify that it properly drives the antenna.
9.			RF BORESIGHT
9.1	BSIGT	PA	Bring PA up.
9.2		SERVO	Press the COLL TWR POSITION PBI.
9.3		TDP	Set the following switches to the positions listed: Switch — Position TDP LOW SPEED TTY FRAME RATE — MANUAL LOW SPEED START/STOP — START DATA — REAL

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
9.4	BSIGT	R/E	Set TRANSPONDER power switch to ON.
9.5		PA	Bring PA power up for station configuration.
9.6		R/E	Set the SCO MODE switch to MODE 6 (switch position 1F).
9.7		Servo & R/E	Secure two-way RF lock with the collimation tower transponder using the tracking frequency specified in the mission documents.
9.8		Servo	Verify that the AUTO TRK/READY indicator lights.
9.9		R/E	Adjust transponder output power for approx -100 dBm as indicated by receiver AGC.
9.10		Servo	Press the AUTO TRK PBI.
9.11		Servo	Allow the antenna to settle to the RF boresight position.
9.12		Servo	Press the MANUAL POSITION PBI.
9.13		Servo	Manually position the antenna to a space angle of approx +0.4 deg (+0.2 deg at 85-foot stations) from the boresight position in X- and Y-axis (HA and DEC at Wing stations). Note Use TV reticle to approximate the offset from boresight.
9.14		Servo	Press the AUTO TRK PBI.
9.15		TDP	After the antenna has settled to boresight, initiate three frames of TDP data. TTY character 7 should be a 7.
9.16		Servo/TDP	Note and compare X- and Y-angles. (The value is decimal from the REAL ANGLE visual display and octal from the TTY printout.)

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
9.17	BSIGT	Servo/TDP	Repeat sequences 9.12 through 9.16 of this paragraph using the following offsets from boresight: -0.4 deg (-0.2 at 85-foot) X- and Y-angles. -0.4 deg (-0.2 at 85-foot) X-angle, +0.4 deg (+0.2 at 85-foot) Y-angle. +0.4 deg (+0.2 at 85-foot) X-angle, -0.4 deg (-0.2 at 85-foot) Y-angle.
9.18		Servo	Check the RF boresight readings at the last antenna alignment. (Use surveyed data contained in the station records.) The values recorded in sequences 9.16 and 9.17 of this section should be within 0.018 deg and 35 octal respectively. Note Sequences 9.19 and 9.20 of this section are not applicable to Wing stations.
9.19		Servo	Manually position the antenna to approximately +4 degrees from the boresight position in both X- and Y-axis using the real-angle readouts.
9.20		Servo	Verify that the antenna will lock up properly in the ACQ mode of operation.
10			Range and Non-Destruct Test
10.1	RNG	Servo & R/E	Verify that two-way lock and autotrack is maintained with the main receiver, and two-way lock is maintained on the ACQ receiver (system 1). Disable both axes to secure antenna during ranging tests. Lock system (receivers 1 and 2) to downlink frequency specified in the mission documents.
10.2		R/E	Set the exciter switches to the positions indicated: Switch — Position MODULATION SELECTOR — NORM SYNTHESIZER LOOP FILTER — OPER SCO MODE SWITCH — Any ranging mode

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
10.3	RNG	R/E	Set the input selector switch to RCVR 2 (ranging receiver control).
10.4		Ranging	Set the controls on the ranging subsystem to the following positions: Control — Position DOPPLER SELECTOR — MANUAL PROGRAM — NORMAL SHIFT — NORMAL STORE — NORMAL CODE — NORMAL CODE SELECTOR — CODE TRACKING FILTER — OPEN CLOCK DOPPLER — To 3 o'clock position
10.5		Ranging	Verify that the ranging subsystem indications are as follows: a. Clock loop Static Phase Errors (SPE) meter should indicate 0. b. Correlation meter should indicate 53 percent of full scale.
10.6		TDP	Set the following switches to the following positions: Switch — Position DATA — REAL DATA SELECT — RCVR 1 TTY FRAME RATE — 1P6S TTY WORD RATE (Data Patch Control Panel) — 100 WPM MODEM FRAME RATE — HIGH LOW SPEED DATA — START COMMUNICATIONS HEADING — NORMAL
10.7		Ranging	Press the ranging subsystem START pushbutton. The PROGRAM STATE indicators should light sequentially from P1 through P7.

USB Metric Data Test (cont)

Seq	Test	Operator	Instructions
10.8	RNG	Ranging	Rotate the CLOCK DOPPLER control ccw to the 10 o'clock position. The TDP RANGE DISPLAY should indicate proper range number for the station.
10.9		TDP & R/E	Set the OBJECT NUMBER switches on the ONSP, and press the VCO SELECTOR PBI's listed in the mission documents to obtain the proper TTY character 9 printout for IU, CSM, and LM. Set the mission ID switch on the TDP to the mission number specified in the mission documents.
10.10		TDP	Press the LOW SPEED DATA PBI to STOP.
10.11		TDP & R/E	Set the switches on the indicated equipment to the positions listed: Equipment — Switch — Position Ranging Receiver — INPUT SELECTOR — RCVR 1 TDP — MODEM FRAME RATE — LOW
10.12		R/E	Lock the exciter VCO to the synthesizer.
10.13		Ranging	Repeat sequence 10.5 of this section. Verify that the RESET light is lit.
10,14		TDP	Press the LOW SPEED DATA PBI to START.
10.15		Ranging	Repeat sequences 10.7, 10.8 and 10.9 of this section.
10.16		TDP	Allow the TDP to output at least 12 frames of data. Verify that characters 46 through 57 are correctly accumulating. Correct accumulation may be verified by reference to Volume I of ME 1538, table 5-3. Note Dual stations should set the TDP DATA SELECT switch to RCVR 2, and repeat sequences 10.1 through 10.16 on system 2. Do not perform during F plus day SRT.

2.3.2 ALASKA (ULA) AND VHF B/U METRIC DATA TESTS

OBJECTIVES

The objectives of these tests are to verify that the topocentric data message will drive the 85-foot and 40-foot antennas properly, verify that all antennas will autotrack and reacquire the boresight tower, and verify the accuracy of the gimbal angle indicators.

TEST DESCRIPTION

The test objectives are accomplished by:

a. Driving the 85-foot and 40-foot antennas using sample drive tapes, and verifying correct antenna response by comparing actual position angles with commanded angles.

b. Confirming that the antennas can acquire and autotrack the collimation signal source.

2.3.2.1 VHF Topo

a. Eighty-five Foot Topo

(1) The station will generate a test topocentric data tape to drive the 85-foot antenna from the minus-X and -Y prelimits to the plus-X and -Y prelimits.

(2) Drive the 85-foot antenna using the test tape.

b. Forty-foot Topo

(1) Station will generate a test topocentric data tape to drive the 40-foot antenna from the minus-X and -Y prelimits to the plus-X and -Y prelimits.

(2) Drive the 40-foot antenna using the test tape.

2.3.2.2 S-band Snap-on

a. Eighty-five Foot Antenna Snap-on

(1) Adjust the boresight tower calibration signal generator for a frequency of 2287.5 MHz at level between -80 and -100 dBm at the input to the preamplifier.

(2) Set the tracking receiver parameters as specified in STDN 601/ERTS.

(3) Position the antenna to the boresight position.

(4) Manually phase-lock the tracking receiver to the test signal.

(5) Reposition the antenna in the X-axis 0.1 degree off boresight.

(6) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(7) Adjust the X-axis for a 1.0-V indication on the X-axis meter.

(8) Reposition the antenna in the X-axis to the opposite side of the boresight and observe that the X-axis error voltage meter needle travels to the opposite polarity indication.

(9) Reposition the antenna to the boresight position.

(10) Reposition the antenna in the Y-axis 0.1 degree off boresight.

(11) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(12) Adjust the Y-axis for a 1.0-V indication on the Y-axis meter.

(13) Reposition the antenna in the Y-axis to the opposite side of the boresight and observe that the Y-axis error voltage meter needle travels to the opposite polarity indication.

(14) Position the antenna 0.5 degree off boresight in both axes.

(15) Select AUTOTRACK mode and observe that the antenna returns to the absolute boresight with a minimal hunting action.

(16) Perform this test three times to ensure repeatability of results.

(17) Compare test results with the known boresight tower X- and Y-position readouts. Test results should agree ±0.01 degree.

b. Forty-foot Antenna Snap-on

(1) Adjust the boresight tower calibration signal generator for a frequency of 2287.5 MHz at level between -80 and -100 dBm at the input to the preamplifier.

(2) Set the tracking receiver parameters as specified in the ERTS NOSP, STDN No. 601/ERTS.

(3) Position the antenna to the boresight position.

(4) Manually phase-lock the tracking receiver to the test signal.

(5) Reposition the antenna in the X-axis 0.1 degree off boresight.

(6) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(7) Adjust the X-axis for a 1.0-V indication on the X-axis meter.

(8) Reposition the antenna in the X-axis to the opposite side of the boresight and observe that the X-axis error voltage meter needle travels to the opposite polarity indication.

(9) Reposition the antenna to the boresight position.

(10) Reposition the antenna in the Y-axis 0.1 degree off boresight.

(11) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(12) Adjust the Y-axis for a 1.0-V indication on the Y-axis meter.

(13) Reposition the antenna in the Y-axis to the opposite side of the boresight and observe that the Y-axis error voltage meter needle travels to the opposite polarity indication.

(14) Position the antenna 0.7 degree off boresight in both axes.

(15) Select AUTOTRACK mode and observe that the antenna returns to the absolute boresight with a minimal hunting action.

(16) Perform this test three times to repeatability of results.

(17) Compare test results with the known boresight tower X- and Y-position readouts. Test results should agree ±0.015 degree.

2.3.2.3 VHF Snap-on

a. Eighty-five Foot Antenna Snap-on

(1) Adjust the boresight tower calibration signal generator for a frequency of 138.0 MHz at level between -80 and -100 dBm at the input to the preamplifier.

(2) Set the tracking receiver parameters as specified in the ERTS NOSP, STDN No. 601/ERTS.

(3) Position the antenna to the boresight position.

(4) Manually phase-lock the tracking receiver to the test signal.

(5) Reposition the antenna in the X-axis 1.0 degree off boresight.

(6) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(7) Adjust the X-axis for a 1.0-V indication on the X-axis meter.

(8) Reposition the antenna in the X-axis to the opposite side of the boresight and observe that the X-axis error voltage meter needle travels to the opposite polarity indication.

(9) Reposition the antenna to the boresight position.

(10) Reposition the antenna in the Y-axis 1.0 degree off boresight.

(11) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(12) Adjust the Y-axis for a 1.0-V indication on the Y-axis meter.

(13) Reposition the antenna in the Y-axis to the opposite side of the boresight and observe that the Y-axis error voltage meter needle travels to the opposite polarity indication.

(14) Position the antenna 3.0 degrees off boresight in both axes.

(15) Select AUTOTRACK mode and observe that the antenna returns to the absolute boresight with a minimal hunting action.

(16) Perform this test three times to ensure repeatability of results.

(17) Compare test results with the known boresight tower X- and Y-position readouts. Test results should agree ±0.1 degree.

b. Forty-foot Antenna Snap-on

(1) Adjust the boresight tower calibration signal generator for a frequency of 138.0 MHz at level between -80 and -100 dBm at the input to the preamplifier.

(2) Set the tracking receiver parameters as specified in the ERTS NOSP, STDN No. 601/ERTS.

(3) Position the antenna to the boresight position.

(4) Manually phase-lock the tracking receiver to the test signal.

(5) Reposition the antenna in the X-axis 1.0 degree off boresight.

(6) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(7) Adjust the X-axis for a 1.0-V indication on the X-axis meter.

(8) Reposition the antenna in the X-axis to the opposite side of the boresight and observe that the X-axis error voltage meter needle travels to the opposite polarity indication.

(9) Reposition the antenna to the boresight position.

(10) Reposition the antenna in the Y-axis 1.0 degree off boresight.

(11) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(12) Adjust the Y-axis for a 1.0-V indication on the Y-axis meter.

(13) Reposition the antenna in the Y-axis to the opposite side of the boresight and observe that the Y-axis error voltage meter needle travels to the opposite polarity indication.

(14) Position the antenna 6.0 degrees off boresight in both axes.

(15) Select AUTOTRACK mode and observe that the antenna returns to the absolute boresight with a minimal hunting action.

(16) Perform this test three times to ensure repeatability of results.

(17) Compare test results with the known boresight tower X- and Y-position readouts. Test results should agree ±0.1 degree.

c. SATAN VHF Antenna Snap-on

(1) Adjust the boresight tower calibration signal generator for a frequency of 138.0 MHz at level between -80 and -100 dBm at the input to the preamplifier.

(2) Set the tracking receiver parameters as specified in the ERTS NOSP, STDN No. 601/ERTS.

(3) Position the antenna to the boresight position.

(4) Manually phase-lock the tracking receiver to the test signal.

(5) Reposition the antenna in the X-axis 1.0 degree off boresight.

(6) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(7) Adjust the X-axis for a 1.0-V indication on the X-axis meter.

(8) Reposition the antenna in the X-axis to the opposite side of the boresight and observe that the X-axis error voltage meter needle travels to the opposite polarity indication.

(9) Reposition the antenna to the boresight position.

(10) Reposition the antenna in the Y-axis 1.0 degree off boresight.

(11) Adjust the tracking receiver AGC control for a maximum indication on the meter.

(12) Adjust the Y-axis for a 1.0-V indication on the Y-axis meter.

(13) Reposition the antenna in the Y-axis to the opposite side of the boresight and observe that the Y-axis error voltage meter needle travels to the opposite polarity indication.

(14) Position the antenna 6.0 degrees off boresight in both axes.

(15) Select AUTOTRACK mode and observe that the antenna returns to the absolute boresight with a minimal hunting action.

(16) Perform this test three times to ensure repeatability of results.

(17) Compare test results with the known boresight tower X- and Y-position readouts. Test results should agree ±0.1 degree.

2.3.3 MINITRACK INTERFEROMETER

OBJECTIVES

The objectives of this test are to verify that the Minitrack Interferometer system will track the Earth Resources Technology Satellite (ERTS) and record the direction cosines, time, and Automatic Gain Control (AGC) levels.

TEST DESCRIPTION

The test objectives are accomplished by injecting a test signal into the system, utilizing the internal calibration system, and recording a few lines of data on the Automatic Digital Recording System (ADRS) and stripchart recorders.

2.3.3.1 On the Control Console, set the following switches:

Switch/Control	Setting/Indication
Receiver frequency switches	137.860 MHz
AGC speed	10 MHz
TRACK RF CALIBRATE switch	CALIBRATE
TRACK-PHASE CALIBRATE switch	TRACK FULL SCALE
TRACK CALIBRATE switches	TRACK

2.3.3.2 On the Mode and Code Control assembly, set the bandwidth selector switch to 10 Hz.

2.3.3.3 Adjust the CAL ADJUST control on the Control Console for a 60-micro-ampere indication on the RF OUTPUT meter.

2.3.3.4 Set the 10 DB and 1 DB STEP ATTENUATORS on the Control Console to -80 dBm and make sure the digital AGC meter on the ADRS control panel indicates 9.

2.3.3.5 Set the RECORDING RATE switch on the ADRS control panel to NORMAL.

2.3.3.6 Set the TEST FEED OPERATE switch on the ADRS control panel to OPERATE. (Operate long enough to print out at least one line of data for each AGC level set.)

2.3.3.7 Using the 10 DB and 1 DB STEP ATTENUATORS, reduce the calibration power level from -80 dBm to -120 dBm in 5-dB steps. On the ADRS, there should be less than 10 counts difference between initial and final NSF and EWF phase counts while reducing the signal level from -80 dBm to -120 dBm. The AGC indication on the ADRS control panel must decrease one unit for each 5 dB of attenuation; i.e.:

DBM	AGC
-80	9
-85	8
-90	7
-95	6
-100	5
-105	4
-110	3
-115	2
-120	1

2.3.3.8 Using the 10 DB and 1 DB STEP ATTENUATORS, reduce the calibration power level from -120 dBm to -130 dBm, in 5-dB steps, and in 1-dB steps from -130 dBm until the digital phase meters become erratic. Erratic reading should occur at about -135 dBm.

2.3.3.9 Place the system in an operational mode by setting the TRACK RF CALIBRATE switch to TRACK POLAR.

2.4 AUTOMATIC GAIN CONTROL CALIBRATION

There are four Automatic Gain Control (AGC) calibration tests:

a. Unified S-band AGC Calibration Test, with two sub-tests:

   (1) Coherent PM AGC Calibration Test.

   (2) Non-coherent FM AGC Calibration Test.

b. Alaska PM AGC Calibration Test (2287.5-MHz S-band).

c. Alaska FM S-band AGC Calibration Test.

d. VHF PM AGC Calibration Test (137.86 MHz).

2.4.1 UNIFIED S-BAND AGC CALIBRATION TESTS

OBJECTIVE

The objectives of these tests are to determine that the receiver Automatic Gain Control (AGC) and threshold levels are within specified tolerances as established by SST 417E-01.

TEST DESCRIPTION

The test objective is accomplished by injecting known signal levels into the parametric amplifier and measuring the receiver AGC voltage. The receiver AGC voltage levels are compared to data obtained during the performance of SST 417E-01 to verify optimum receiver performance.

TEST CONFIGURATION

Configure the equipment as shown in figure 2-3.

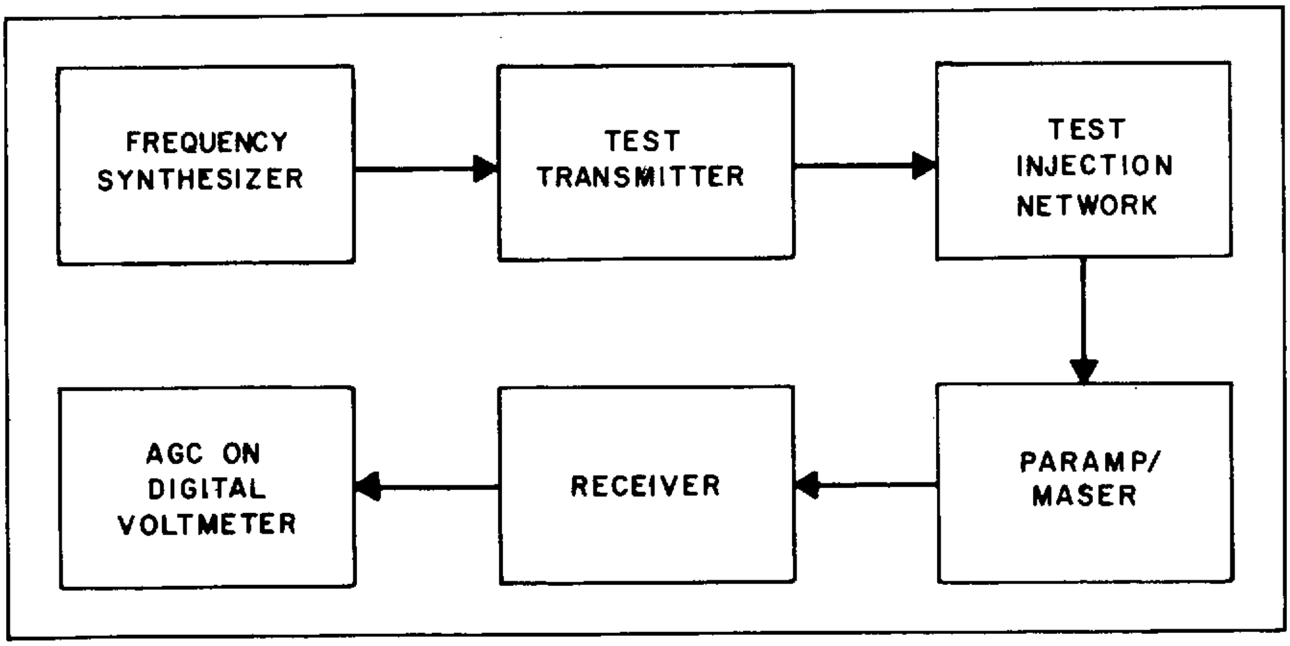


Figure 2-3. Test Setup for AGC/Threshold

2.4.1.1 Coherent PM AGC Calibration Test

a. Acquire the test transmitter output with No. 1 receiver.

b. Select the receiver LOOP BANDWIDTH specified in STDN No. 601/ERTS.

c. Adjust the test transmitter output for -70 dBm input into the paramp. Adjust in 15-dB steps to -145 dBm, then go to threshold. Record AGC levels and threshold level on data sheet.

Note

> Threshold is defined as the point where the receiver AGC voltage drops out of lock for 50 percent of the time as indicated on the RECEIVER LOOP, and OUT OF LOCK/IN LOCK indicators.

d. Compare data points to AGC curve obtained in SST 417E-01. Data point repetition should be ±2 dB. Record on data sheet.

e. Repeat steps 2.4.1.1a through 2.4.1.1d for additional receivers as required for the mission.

2.4.1.2 Non-coherent FM AGC Calibration Test (Launch Vehicle)

a. Set the correct frequency synthesizer input into the test transmitter 19 MC IN jack. The launch vehicle frequency is 2241.5 MHz.

b. Tune the receiver to receive the test transmitter carrier output.

c. Adjust the test transmitter output for -70 dBm to the paramp and note the non-coherent AGC voltage. Adjust the test transmitter and record the AGC level for each increment on the data sheet.

d. Compare data points to non-coherent AGC curve obtained in SST-417E-01. Curve repetition must be ±2 dB. Record on data sheet.

e. Repeat steps 2.4.1.2a through 2.4.1.2d for each additional receiver required for mission support.

2.4.1.3 Non-coherent FM AGC Calibration Test (MSS and RBV)

a. Set the correct frequency synthesizer input into the test transmitter 19 MC IN jack. The MSS/RBV frequencies are 2265.5 MHz and 2229.5 MHz.

b. Tune the receiver to receive the test transmitter carrier output.

c. Adjust the test transmitter output for -60 dBm into the parametric amplifier and note the non-coherent AGC voltage. Adjust the test transmitter and record the AGC level for each increment on the data sheet.

d. Compare data points to the non-coherent AGC curve obtained in SST-417E-01. Curve repetition must be within ±2.0 dB. Record on data sheet.

e. Repeat steps 2.4.1.3a through 2.4.1.3d for each receiver link required for mission support.

DATA SHEET
USB COHERENT
AGC CALIBRATION CHECK

Mission No. ______________________ Date______________

Operator__________________________Time Start_______________Time End_________
(Record actual test time only)

Note

Upon completion of Section II, all data sheets are to be forwarded to the OPSR.

MAIN PARAMP

Signal Level (dBm)	AGC Level (Vdc)			
	Rcvr No. 1	Rcvr No. 2	Rcvr No. 3	Rcvr No. 4
-70	________	________	________	________
-85	________	________	________	________
-100	________	________	________	________
-115	________	________	________	________
-130	________	________	________	________
-145	________	________	________	________
Threshold	________	________	________	________
Points within ± 2 dB				
	________OK	________OK	________OK	________OK

ACQ PARAMP
AGC Level (Vdc)

Signal Level (dBm)	Rcvr No. 2
-70	________
-85	________
-100	________
-115	________
-130	________
-145	________
Threshold	________

Points within ± 2 dB . . . . __________OK

DATA SHEET
NON-COHERENT
AGC CALIBRATION CHECK
(LAUNCH VEHICLE)

Mission No. ______________________ Date ______________

Operator ______________ Start ________ Finish Time ______
(Record actual test time only)

Note

Upon completion of Section II, all data sheets are to be forwarded to the OPSR.

MAIN PARAMP

Signal Level	AGC Level (Vdc) Rcvr No. 1	Rcvr No. 2	Rcvr No. 3	Rcvr No. 4
-70 dBm	______	______	______	______
-85 dBm	______	______	______	______
-100 dBm	______	______	______	______
-110 dBm	______	______	______	______
-115 dBm	______	______	______	______
-120 dBm	______	______	______	______
Points within ± 2 dB	______ OK	______ OK	______ OK	______ OK

ACQ PARAMP

Signal Level	AGC Level (Vdc) Rcvr No. 2
-70 dBm	______
-85 dBm	______
-100 dBm	______
-110 dBm	______
-115 dBm	______
-120 dBm	______
Points within ±2 dBm	______ OK

DATA SHEET
NON-COHERENT
AGC CALIBRATION CHECK
(MSS/RBV)

Mission No.____________________ Date________________

Operator__________________ Start_________ Finish Time_______
(Record actual test time only)

Note

Upon completion of Section II, all data sheets are to be forwarded to the OPSR.

MAIN PARAMP

Signal Level	AGC Level (Vdc) MSS Rcvr	AGC Level (Vdc) RBV Rcvr
-60 dBm	_____	_____
-70 dBm	_____	_____
-80 dBm	_____	_____
-90 dBm	_____	_____
-100 dBm	_____	_____
-105 dBm	_____	_____
Points within ±2 dB	_____OK	_____OK

ACQ PARAMP

Signal Level	AGC Level (Vdc) Rcvr No. 2
-60 dBm	________
-70 dBm	________
-80 dBm	________
-90 dBm	________
-100 dBm	________
-105 dBm	________
Points within ±2 dBm	________OK

2.4.2 ALASKA PM AGC CALIBRATION TEST (2287.5 MHz S-BAND)

OBJECTIVE

The objective of this test is to determine that receiver Automatic Gain Control (AGC), threshold levels, and IRIG, Subcarrier Oscillator (SCO)/Magnetic tape responses are within acceptable limits.

TEST DESCRIPTION

The test objective is accomplished by injecting calibrated test signal levels into the system, recording the AGC levels, outputting the reproduced signals to an IRIG discriminator and stripchart recorder.

2.4.2.1 Point the 85-foot antenna to a known quiet point in the sky.

2.4.2.2 Set the operating controls on the Multifunction Receiver (MFR) No. 1,RCVR No. 1 in accordance with STDN No. 601/ERTS.

2.4.2.3 Using the 2200-MHz test injection system, set the unmodulated input frequency to 2287.5 MHz and an input power level of 80 dBm at the preamplifier input. Ensure that the phase-locked demodulators are locked to the signal.

2.4.2.4 Slowly decrease the input power level to the preamplifier at a rate not to exceed one increment per 5 seconds and record AGC level every 10 dB until loss of lock occurs.

2.4.2.5 Using the stripchart recorders, confirm that the AGC step functions have been properly recorded.

2.4.2.6 Record the threshold level in dBm. Threshold level should be within ±2 dB of -144 dBm.

2.4.3 ALASKA FM S-BAND AGC CALIBRATION TEST

OBJECTIVE

The objective of this test is to determine that the RBV and MSS receivers Automatic Gain Control (AGC), threshold levels, and IRIG Subcarrier Oscillator (SCO)/magnetic tape responses are within acceptable limits.

TEST DESCRIPTION

The test objective is accomplished by injecting calibrated test signal levels into the RBV and MSS systems, recording the AGC, and outputting the reproduced signals to an IRIG discriminator and stripchart recorder.

2.4.3.1 RBV AGC Calibration Test

a. Point the 85-foot antenna to a known quiet point in the sky.

b. Set the operating controls on the Multifunction Receiver (MFR) No. 2, RCVR No. 1 as specified in STDN No. 601/ERTS (2229.5 MHz).

c. Using the 2200-MHz test injection system, set the unmodulated input frequency to 2229.5 MHz and an input power level of -80 dBm at the preamplifier input.

d. Slowly decrease the input power level to the preamplifier at a rate not to exceed one increment per 5 seconds and record AGC level every 10 dB until loss of lock occurs.

e. Using the stripchart recorder, confirm that the AGC step functions have been properly recorded. Record the threshold in dBm. The threshold level should be within ±2 dB of -144 dBm.

2.4.3.2 MSS AGC Calibration Test

a. Set the operating controls on MFR No. 1, RCVR No. 2 as specified in NOSP, STDN No. 601/ERTS (2265.5 MHz).

b. Using the 2200-MHz test injection system, set the unmodulated input frequency to 2265.5 MHz and an input power level of -80 dBm at the preamplifier input.

c. Slowly decrease the input power level to the preamplifier at a rate not to exceed one increment per 5 seconds and record AGC level every 10 dB, until loss of lock occurs.

d. Using the stripchart recorders, confirm that the AGC step functions have been properly recorded. Record the threshold in dBm. The threshold level should be within ±2 dB of -144 dBm.

2.4.4 VHF PM AGC CALIBRATION TEST (137.86 MHz)

OBJECTIVE

The objective of this test is to determine that receiver Automatic Gain Control (AGC), threshold levels, and IRIG Subcarrier Oscillator (SCO)/magnetic tape responses are within acceptable limits.

TEST DESCRIPTION

The test objective is accomplished by injecting calibrated test signal levels into the system, recording the AGC levels, and outputting the reproduced signal to an IRIG discriminator and stripchart recorder.

2.4.4.1 Point the Link 1 antenna to a known quiet point in the sky.

2.4.4.2 Set the operating controls of the receiver (MFR/DTR-Demodulator) as specified in STDN No. 601/ERTS (137.86 MHz).

2.4.4.3 Using the 136-MHz test injection system, set the unmodulated input frequency to 137.86 MHz and an input power level of -80 dBm at the preamplifier input. Ensure that the phase-locked demodulators are locked to the signal.

2.4.4.4 Slowly decrease the input power level to the preamplifier at a rate not to exceed one increment per 5 seconds and record AGC level every 10 dB, until loss of lock occurs.

Using the stripchart recorders, confirm that the AGC step functions have been properly recorded. Record the threshold in dBm. The threshold level should be within ±2 dB of -151 dBm.

2.5 UPLINK DATA TESTS

There are three uplink data tests:

a. Unified S-Band Uplink Data Tests.

b. CAGE VHF Uplink Data Test.

c. OGO Encoder VHF Uplink Data Test.

2.5.1 UNIFIED S-BAND UPLINK DATA TESTS

OBJECTIVE

The objective of this test is to verify that the Updata Buffer (UDB) phasing and signal levels are correct, and that the modulation index of the modulating signal for each mode agrees with the Network Operations Support Plan for the Earth Resources Technology Satellite (ERTS), STDN No. 601/ERTS.

TEST DESCRIPTION

The test objective is accomplished by measuring the output phase of the UDB, the output frequency, and the peak-to-peak output voltage. The Phase Modulation (PM) indices are verified by comparing the output meter readings with the proper voltage ratio of the carrier suppression chart.

PREREQUISITES

The following prerequisites must have been met:

a. UDB must have power applied, be in the OPERATE mode, and idling with an all 1's pattern.

b. Subcarrier Oscillators (SCO's) must be on and operating in a normal updata mode.

c. The Unified S-band (USB) receiver must be on, and locked to the translated unmodulated uplink frequency.

2.5.1.1 USB/Updata Buffer Interface

a. Set the TEST/OPERATE switch to TEST; then to OPERATE. Observe that status register bit 26 is extinguished to verify that the USB command equipment is operational.

b. Measure the modulator No. 1 output phase of the UDB using the phase meter. The phase meter reading should be as established in ST-09 to produce a zero-phase relationship at the 70-kHz SCO input.

c. Using an oscilloscope, measure the composite UDB signal at the input test point of SCO No. 1 and 2. A 5-Vpp undistorted 1's pattern with zero-phase indication should be present (see figure 2-4). Also verify 1 cycle per msec.

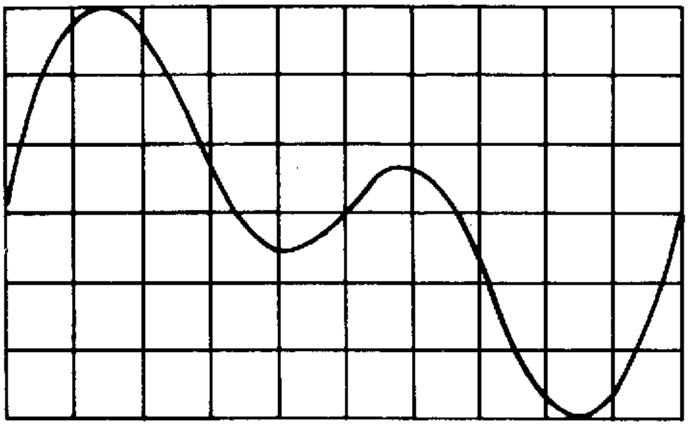


Figure 2-4. Waveform for UDB Signal

d. Repeat steps 2.5.1.1b and c for modulator No. 2.

Note

Reverse the modulators by removing and reinstalling card B49 on the UDB.

e. Set the TEST/OPERATE switch to TEST. Using an oscilloscope, verify that R1 is adjusted for 2.5 Vpp (±0.25 V) measured at card E5 TP_2 (PSK demod No. 1).

f. Set the TEST/OPERATE switch to OPERATE. Using the oscilloscope, verify that the verification receiver output is adjusted for 2.5-Vpp (± 0.25 V) measured at card E5 TP_2.

g. Repeat steps 2.5.1.1 e and f for PSK demodulator No. 2, using card E14 TP_2.

h. The PSK data level should be approximately 7 Vpp at the output of the verification receiver at this time, but may vary somewhat from station to station due to circuit tolerances.

i. Repeat this test for the backup UDB if on station.

2.5.1.2 USB Uplink PM Modulation Index

a. Lock the USB receiver to the translated unmodulated uplink frequency.

b. Set the Manual Gain Control (MGC) to equal the Automatic Gain Control (AGC) reading on the digital voltmeter.

c. Peak the wave analyzer to the 20-kHz carrier measurement signal.

d. Adjust the input level of the wave analyzer to 1 Vrms on the wave analyzer meter.

e. Switch the input of the digital voltmeter to the MOD INDEX position.

f. Adjust the MGC to obtain 1.000 V on the digital voltmeter, provided the adjustment does not exceed ±3 mV.

g. Set modulation selector to NORM.

h. Verify that the modulation index of each modulating signal for each mode agrees with STDN No. 601/ERTS. The digital voltmeter reading should compare with the proper voltage ratio of the carrier suppression chart (see figures 2-5 and 2-6).

i. Use the following USB SCO MODE switch positions for modulation index verification:

Mode	Ranging MK-1 Code Selector Switch	CMD Data	Carrier Suppression
1	CLOCK	OFF	1.14 dB
3	OFF	ON	2.32 dB
5	CLOCK	ON	3.50 dB

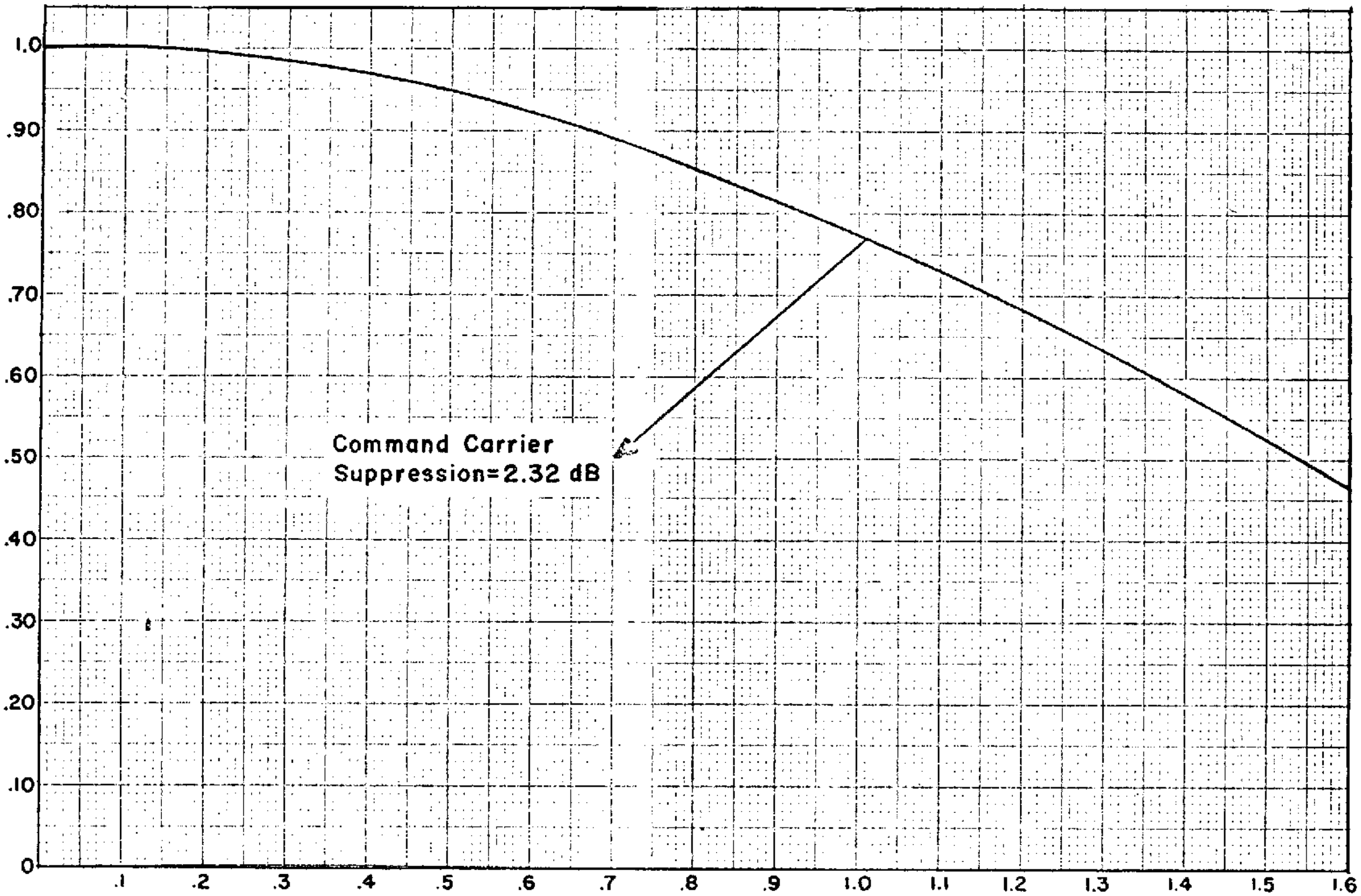


Figure 2-5. PM Modulation Index (Radians) (Sine Wave Modulation)

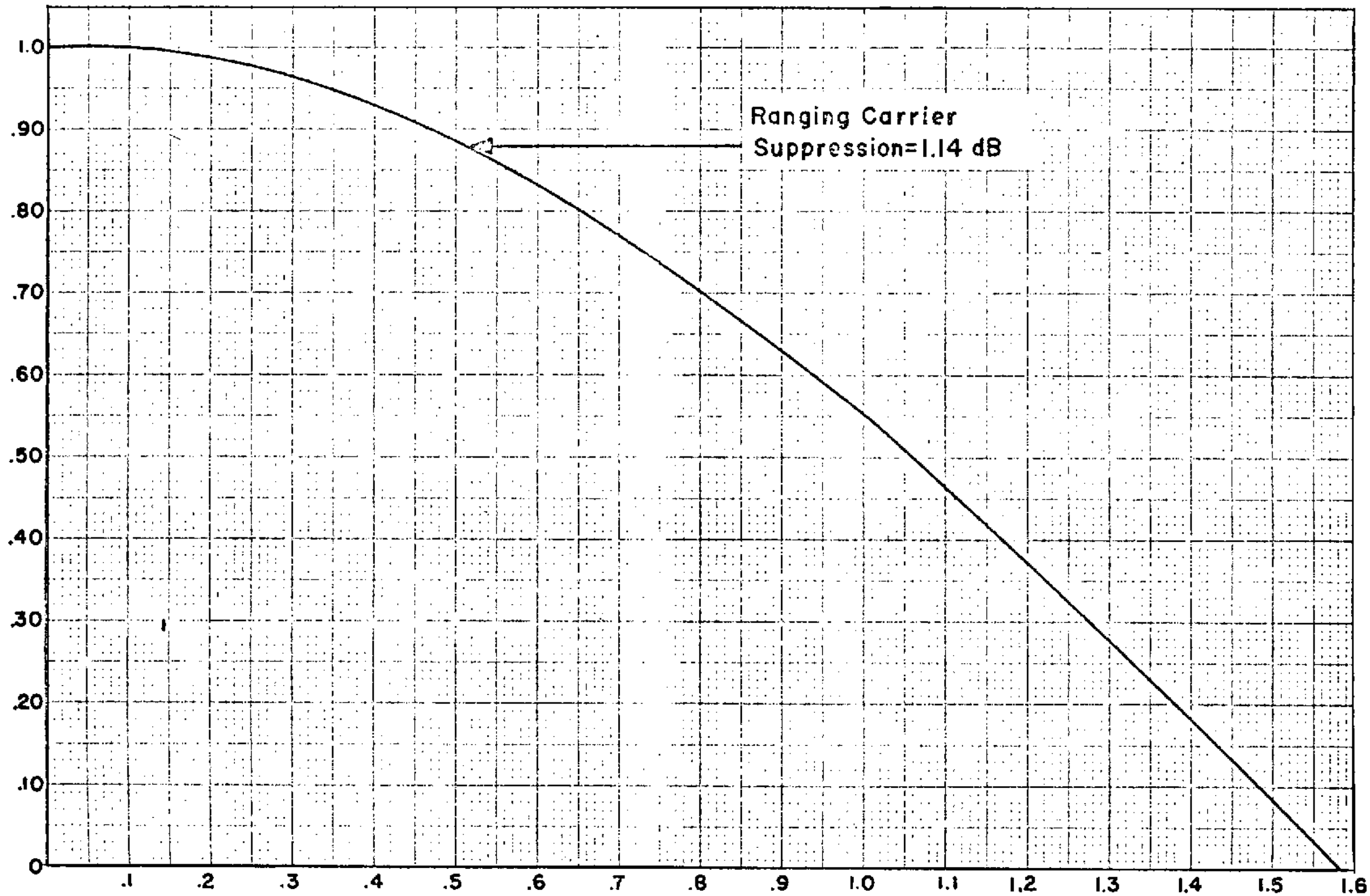


Figure 2-6. Square Wave PM Modulation Index (Radians)

2.5.2 CAGE VHF UPLINK DATA TEST

OBJECTIVE

The objective of this test is to verify that the Command Analog Generation Equipment (CAGE) VHF uplink modulation/data is compatible with the ERTS mission requirements.

TEST DESCRIPTION

The test objective is accomplished by measuring all frequency components of the uplink. Verify correct phasing of the 128-Hz sync with the 128 Bps non-return to Zero (NRZ) data, and verify the FSK and AM/AM modulation indexes.

PREREQUISITE

Prior to this test, the transmitter should be tuned to the mission frequency and set to the mission-required power. Refer to table 2-1 for nominal settings.

Note

> The Command Analog Generation Interface Test (CAGIT) program may be utilized in the RSDP to generate alternate 1-0 patterns for verifying sync and DATA phasing.

Table 2-1. Transmitter Operating Parameters

Power[1] Level	PA GRID BIAS Control (% open)	PA GRID DRIVE Control (% open)	PA Grid Current (mA)	PA Screen Current (mA)	PA Cathode Current (Amp)	Power Output (kW)	Plate Volts (dc)	PA Driver Cathode (mA)	PA Driver Grid (mA)	Mult. Plate Current (mA)	PA Filament (volts)	Modulator Cathode Current I & II[2]
6	70-100	60-90	35-45	60-90	1.3-1.5	2.5+	3300-3500	250-300	5-40	160-200	9.0-9.4	.210-.260
5	50-75	40-70	20-40	40-75	1.3-1.5	1.8+	2600-2900	160-250	5-40	160-200	9.0-9.4	.210-.260
4	50-75	30-60	15-30	40-90	1.1-1.3	1.4+	2000-2300	140-200	5-40	160-200	9.0-9.4	.210-.260
3	30-50	30-50	15-30	60-100	1.1-1.3	1.0+	1500-1800	140-200	5-40	160-200	9.0-9.4	.210-.260
2	20-40	20-40	10-20	60-100	1.0-1.2	0.5+	1300-1500	140-200	5-40	160-200	9.0-9.4	.210-.260
1	10-40	20-40	10-20	70-120	.95-1.1	0.25+	1000-1200	140-200	5-40	160-200	9.0-9.4	.210-.260

[1] In the medium-power configuration, power level is selected by the POWER switch on the power supply drawer; for example, power level 6 corresponds to POWER switch position 6. In the ATS configuration, power level is selected by attenuation controls on either the local or the remote RF output attenuation control panel; the power level corresponds to the attenuation level selected as follows:

Power Level	Attenuation Level Selected
1	10 or 30 dB
2	8 or 28 dB
3	6 or 26 dB
4	4 or 24 dB
5	2 or 22 dB
6	0 or 20 dB

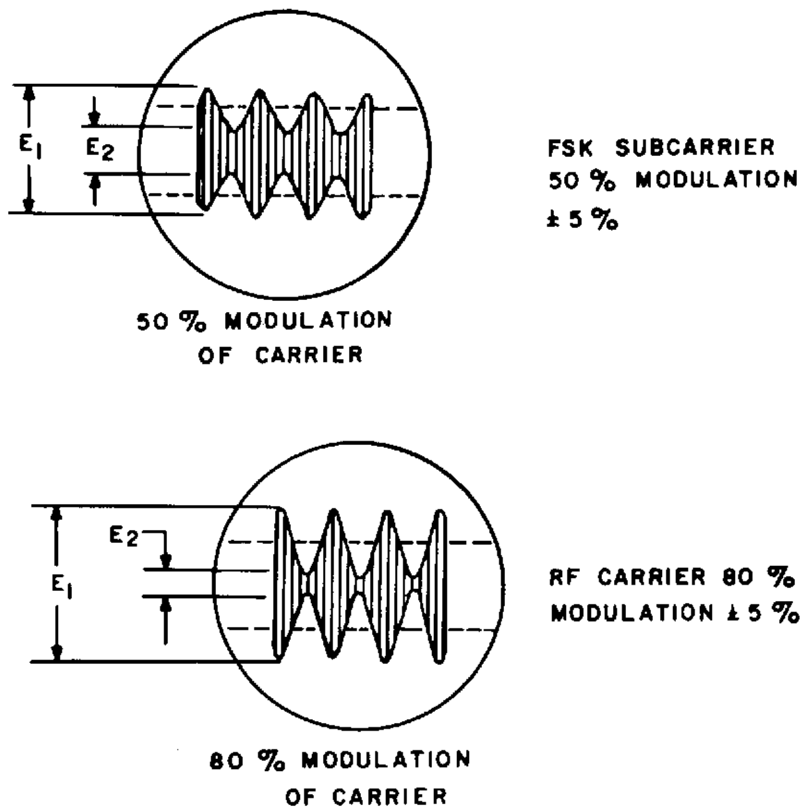
[2] Modulator cathode currents should be balanced within 0.010 Amp.

CAGE VHF Uplink Data Test

Seq	Operator	Instructions
1	CAGE	Set the CAGE encoder OPERATE/TEST switch to TEST. Set the encoder TEST 8.0/8.6 switch to 8.0. Connect a frequency counter to the commands-out BNC connector on the encoder front panel and measure the 8.0-kHz subcarrier frequency. Measured frequency should be 8.0 kHz (±2.0 Hz).
2	CAGE	Set the encoder 8.0/8.6 test switch to 8.6. Measure the 8.6-kHz subcarrier frequency on the frequency counter. Measured frequency should be 8.6 kHz (±2.0 Hz).
3	CAGE	Disconnect the frequency counter from the commands-out BNC and connect to the 128-Hz sync BNC. Measure the frequency of the 128-Hz sync with the frequency counter set for x10 measurement. Measured frequency should be 128.0 Hz (±0.2Hz).
4	CAGE	Connect channel A of the dual channel oscilloscope to monitor the encoder commands-out front panel BNC. Connect channel B of the dual-channel oscilloscope to monitor the NRZ IN BNC on the encoder front panel. Sync the oscilloscope on the NRZ data using external sync input.
5		Set up the oscilloscope to display channel A only. Verify 50 percent (±5 percent) (AM) modulation of the 8.0/8.6-kHz subcarrier by the 128-Hz sync. (See figure 2-7)
6	CAGE/RSDP	Set the encoder OPERATE/TEST switch to OPERATE. Set the oscilloscope for chopped A/B display. Initiate a command sequence at the RSDP or CAGE interface buffer. Verify that the negative going zero crossover of the 128-Hz sync is coincident with leading edge of the NRZ bit period within ±200 microseconds. (See figure 2-8)
7	VHF XMTR	Verify that the transmitter is ON with the dummy load selected and STANDBY indicator is lit. Verify that the MODE SELECT switch is set to PCM/AM/AM.

CAGE VHF Uplink Data Test (cont)

Seq	Operator	Instructions
8	VHF XMTR	Verify that the POWER switch is set to provide mission-required power (2.0 kW nominal power required). Operate the PLATE VOLTS START pushbutton switch and verify that the PLATE VOLTS indicator lights.
9	VHF XMTR	Operate the CARRIER START pushbutton switch and verify presence of carrier on the POWER OUTPUT meter. With no modulation applied to the transmitter, connect a frequency counter to the FREQ CHECK test point and measure the VHF carrier frequency. The frequency should be 152.4 MHz (±100 Hz).
10	VHF XMTR/CAGE	Connect an oscilloscope to the MOD RF CHECK test point and adjust the oscilloscope controls to display the RF carrier signal. Apply the CAGE encoder composite output signal to modulate the VHF carrier.
		Verify a VHF carrier modulation of 80 percent (±5 percent) as measured on the oscilloscope. Verify 2.0 kW nominal output power on the POWER OUTPUT meter with 80 percent (±5 percent) modulation.
11	VHF XMTR	Operate the PLATE VOLTS STOP pushbutton switch and verify that the PLATE VOLTS indicator is extinguished and the POWER OUTPUT meter goes to zero. Disconnect the transmitter from the dummy load and connect to the antenna. Reconfigure all equipment for mission support as specified in STDN No. 601/ERTS. END TEST



Note

1. E_1 is peak-to-peak amplitude of carrier at positive peak of modulating signal.

2. E_2 is peak-to-peak amplitude of carrier at negative peak of modulating signal.

3. Modulating percentage =

$$\frac{E_1 - E_2}{E_1 + E_2} \times 100$$

Figure 2-7. VHF Modulation Envelopes

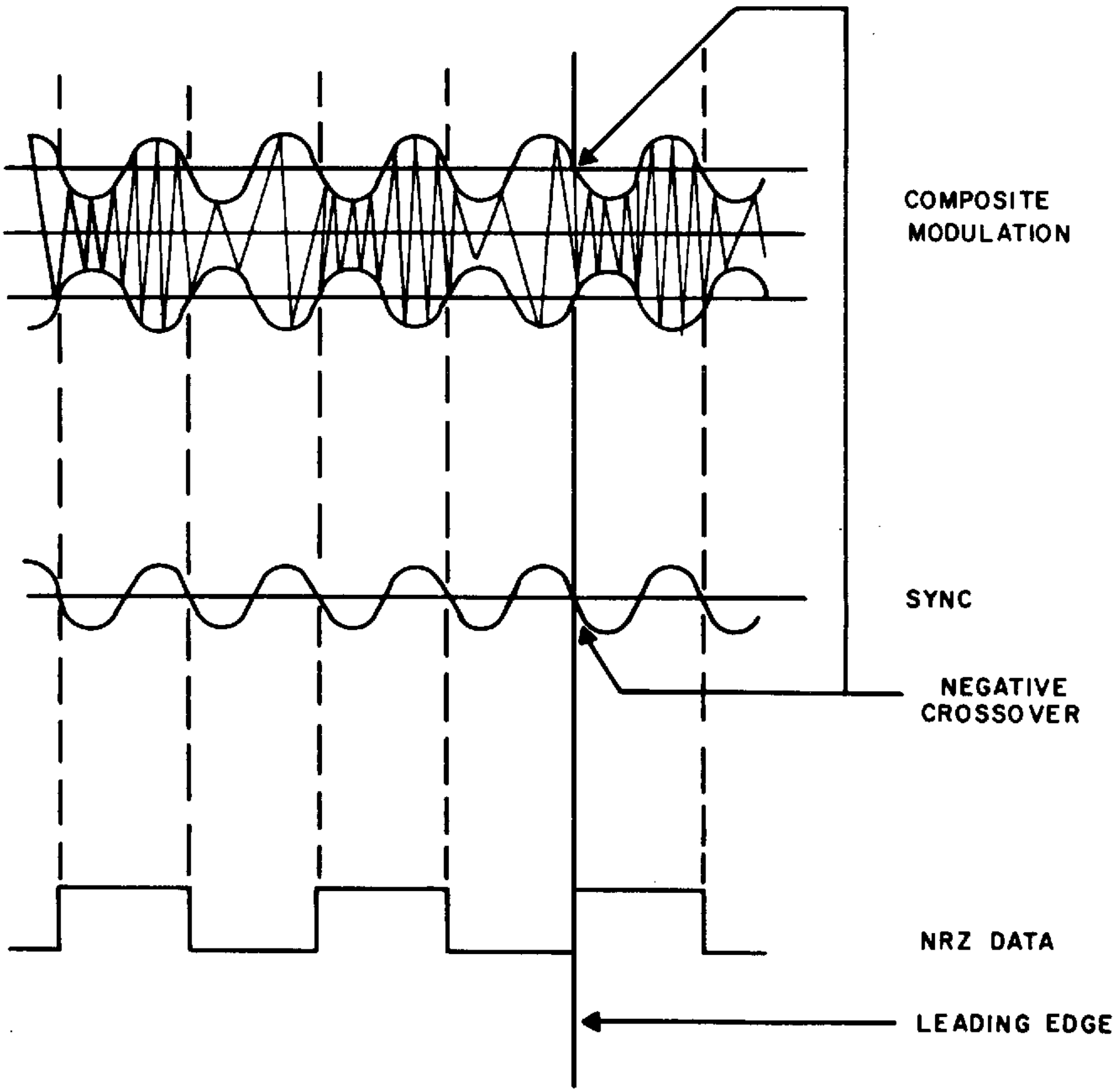


Figure 2-8. CAGE Command Modulation Phasing

2.5.3 OGO ENCODER VHF UPLINK DATA TEST

OBJECTIVE

The objective of this test is to verify that the modified Orbiting Geophysical Observatory (OGO) encoder is capable of commanding the Earth Resources Technology Satellite (ERTS).

TEST DESCRIPTION

The test objective is accomplished by generating an ERTS command, using the OGO Command encoder; modulating the CMD transmitter (terminated into a dummy load); and sampling, demodulating, and printing the command message for visual comparison.

TEST PROCEDURE

2.5.3.1 Input OGO CMD encoder into the CMD transmitter.

2.5.3.2 Select EXT mode for CMD verification.

2.5.3.3 Configure the CMD transmitter for a carrier frequency of 154.20 MHz, and a modulation of 80 percent.

2.5.3.4 Terminate the transmitter into a dummy load.

2.5.3.5 Set the OGO/ERTS switch to ERTS.

2.5.3.6 Select PAPER TAPE CONTROL on the control panel.

2.5.3.7 Insert an ERTS-formatted command tape in the paper tape reader.

2.5.3.8 Press the TRANSMIT pushbutton.

2.5.3.9 Verify that the printout from the digital printer shows the same address and command that was on the paper tape.

2.5.3.10 Verify no error indication from error indicator.

2.5.3.11 Reconfigure the transmitter to radiate into the antenna at mission power.

2.6 PM DOWNLINK DATA TESTS

There are two PM downlink data tests:

a. S-band PM Downlink Data Test.

b. VHF PM Downlink Data Test.

2.6.1 S-BAND PM DOWNLINK DATA TEST

OBJECTIVE

The objective of this test is to verify the integrated systems performance from the parametric amplifier input through postdetection of the data streams.

TEST DESCRIPTION

The test objective is accomplished by modulating the S-band PM test transmitter with a simulated mission modulation/data scheme. The output of the test transmitter is injected into the parametric amplifier. Postdetection bit error rates are measured to verify the integrated systems performance at specific parametric amplifier input levels.

2.6.1.1 General

a. The ETC ERTS station should coordinate these tests with the ERTS-OCC since all detection and simulation equipment except DCS are physically located at the OCC. ERTS OCC ground station personnel will perform the telemetry and recorder operator functions of the real time and dump test sequences and will utilize the HP-1900 pulse system for PCM simulation and error detection, vice PCM simulator and bit comparator.

b. The ETC station TC is the coordinator for this testing and will require real time and dump data support from the ERTS OCC.

c. The BERTS program (TESOC Control No. 6-701) should be utilized in the MSFTP-2 simulator for the ERTS real time and dump mode bit error rate tests. The ERTS SEQ 1043S (TESOC Control No. 4-043) simulator program may be used if the BERTS program is not available.

2.6.1.2 Test Procedures. To perform the S-band PM downlink data test, use the following procedures.

S-band PM Downlink Data Test

Seq	Test	Operator	Instructions
1	RT	TC/USB/TLM* RCDR/MFR	Configure the equipment as shown in figure 2-9, 2-10, 2-11, or 2-12 for applicable stations.
2	RT	USB/TLM*/MFR	Set up the USB, MFR, and TLM equipment in accordance with tables 2-2 and 2-3.
3	RT	USB/TLM*/MFR	Set up the individual subcarriers to phase modulate the S-band test transmitter as follows: Subcarrier — Mod Index — Carrier Suppression RT 768 kHz — 0.30 radian — 0.2 dB DT 597 kHz — 0.81 radian — 1.5 dB DCS 1.024 MHz — 0.99 radian — 2.3 dB Composite — — 4.0 dB (total) Note ETC ERTS station personnel should verify optimum reception of the 597 and 768 kHz subcarrier signals from the ERTS OCC prior to setting the modulation indicies.
4	RT	TLM	Set up the PCM simulator for 1-kb/sec split phase data. Set the PCM simulator 1-kb/sec output to PSK the 768-kHz SCO ±90 degrees.
5	RT	USB/MFR	Position the antenna to quiet sky and lock the receiver to the S-band test transmitter 2287.5-MHz carrier.
6	RT	USB/MFR	With the 1.024-MHz, 597-kHz, and 768-kHz subcarrier oscillators connected to simultaneously phase modulate the PM test transmitter, set the test transmitter for a suppressed carrier level (AGC reference) into the parametric amplifier which corresponds to 1 error in 10^5 as determined from the data which has been entered on the graph of figure 1-5 in section 1.
7	RT	TLM*	Adjust the delay on the bit comparator until the SEL DATA and DELAYED DATA signals are in phase as displayed on channels A and B of the oscilloscope.

* For NTE testing, the TLM operator is located at the OCC.

S-Band PM Downlink Data Test (cont)

Seq	Test	Operator	Instructions
8	RT	RCDR *	Verify correct record level of the real-time data at the magnetic tape recorder by recording, reproducing, and monitoring the recorded and reproduced data.
9	RT	TLM/TC *	With the Atec BER counter set up for a 10^5 BER measurement, press the RESET switch and record the error count. Repeat the error count twice and report the average of the three readings to the Test Conductor.
10	RT	USB/MFR	Attenuate the input to the parametric amplifier by 2 dB.
11	RT	USB/MFR/ TLM/TC	Repeat sequences 9 and 10 to obtain a total of three data points. Verify that the three data points meet the test criteria of figure 2-13.
12	Dump	TLM*	Set up the PCM simulator to generate a 24-kb/sec split phase data stream. Set the PCM simulator 24-kb/sec output to PSK the 597-kHz SCO ±90 degrees.
13	Dump	USB/TLM/MFR*	With the 1.024-MHz, 597-kHz, and 768-kHz subcarrier oscillators connected to simultaneously modulate the PM test transmitter, set the test transmitter output for a suppressed carrier level (AGC reference) into the parametric amplifier which corresponds to 1 error in 10^6 as determined from the data entered on figure 1-7 in section 1.
14	Dump	TLM *	Adjust the delay on the bit comparator until the SEL DATA and DELAYED DATA signals are in phase as displayed on the oscilloscope.
15	Dump	RCDR *	Verify correct record level of the dump data at the magnetic tape recorder by recording, reproducing, and monitoring the recorded and reproduced data.

*For NTE testing, the TLM and RCDR operator are located at the OCC.

Seq	Test	Operator	Instructions
16	Dump	TLM*	With the Atec BER counter set up for a 10^6 BER measurement, press the RESET switch and record the error count.
17	Dump	TLM/TC*	Repeat step 16 twice and report the average of the three readings to the TC.
18	Dump	USB/MFR	Attenuate the input to the parametric amplifier by 2 dB.
19	Dump	USB/MFR	Repeat sequences 16, 17 and 18 to obtain a total of 3 data points. Verify that the three data points meet the test criteria of figure 2-14.
			Note Sequences 20 through 28 are applicable to prime ERTS stations only.
20	DCS	USB/MFR/DCS/ TLM*	With the 1.024-MHz, 597-kHz, and 768-kHz subcarriers connected to simultaneously modulate the test transmitter, reset the test transmitter output for a suppressed carrier level (AGC reference) of -112 dBm (-110 dBm at Alaska) into the parametric amplifier.
21	DCS	RCDR	Verify correct record level of the following DCS signals at the recorder inputs: a. FM demod IF output. b. FM demod video output. c. Conv decoder clock output. d. Conv decoder data output. e. Serial decimal time code.

*For NTE testing, the TLM is located at the OCC.

S-Band PM Downlink Data Test (cont)

Seq	Test	Operator	Instructions
22	DCS	DCS	Set the STU TEST MODE CONTROL RUN/HOLD PBI to HOLD. Press DISPLAY CLEAR PBI.
23	DCS	RCDR/DCS	Load the magnetic tape recorder with clean tape. Set the STU TEST MODE CONTROL RUN/HOLD PBI to RUN. Select MESSAGE COUNTER on the STU display.
24	DCS	RCDR	Start the tape recorder and record a short interval of data. Stop the recorder, rewind, and play back the recorded data. Verify optimum recording of the recorded data by monitoring each of the recorded signals during playback.
25	DCS	DCS	When the STU MESSAGE COUNTER display indicates 20,000, set the RUN/HOLD PBI to HOLD.
26	DCS	DCS/TC	Selectively display the contents of the MESSAGE COUNTER, GOOD MESSAGES, BAD MESSAGES, and MESSAGE ERRORS at the STU display. Report the contents of each counter display to the TC.
27	DCS	TC	Verify missed message rate is less than 5×10^{-2} and message error rate is less than 1×10^{-3} Calculate the missed message rate and message error rate as follows: Missed message rate $= \dfrac{\text{Message counter - Good messages}}{\text{Message counter}} \leq 5 \times 10^{-2}$ Message error rate $= \dfrac{\text{Message errors}}{\text{Good messages}} \leq 1 \times 10^{-3}$
28	DCS	DCS	Press the STU DISPLAY CLEAR PBI. Press the formatter/buffer MASTER CLEAR PBI and verify that the CLEAR TO SEND indicator is on.

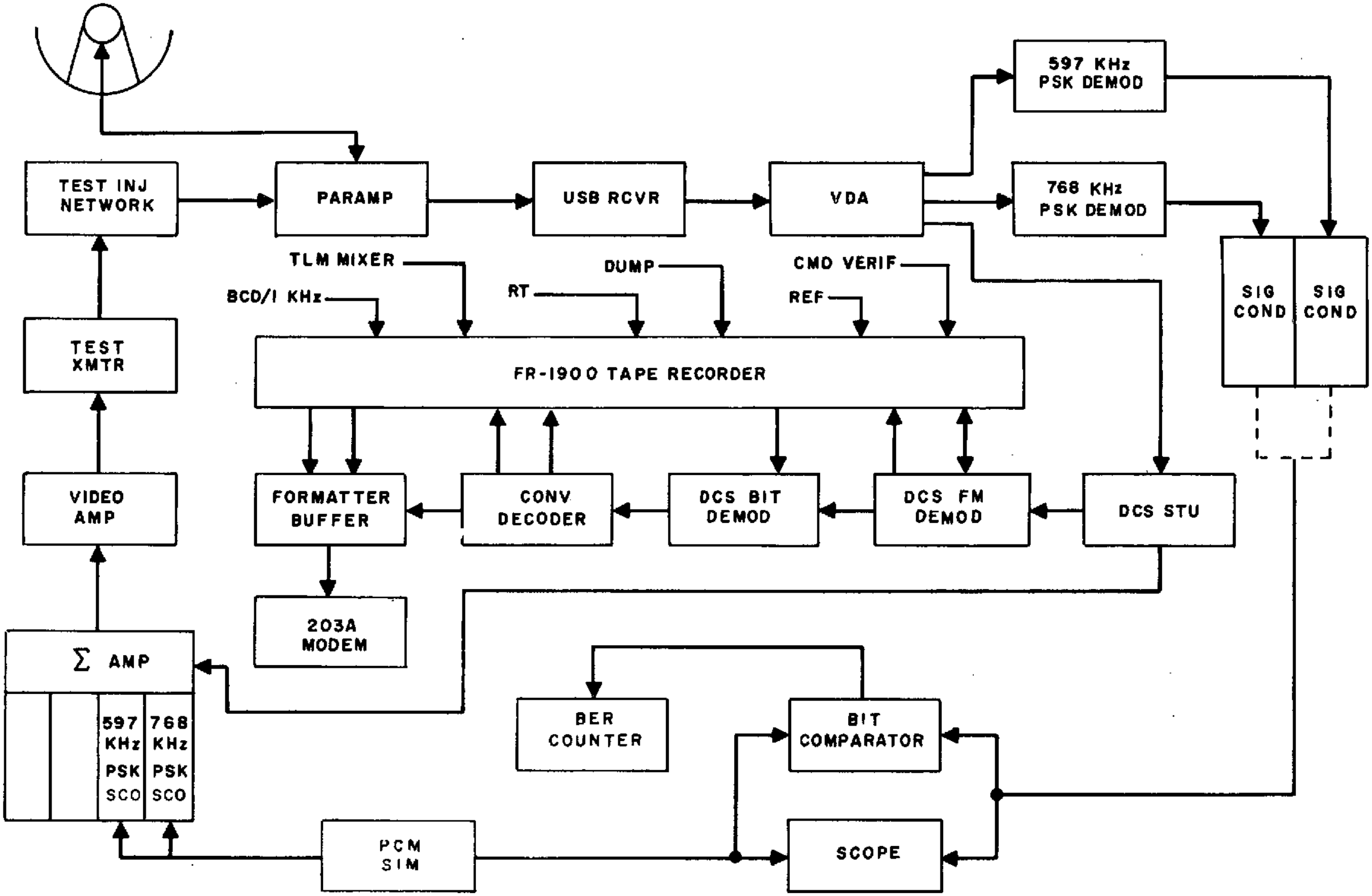


Figure 2-9. S-band PM Downlink Test Configuration (Goldstone ERTS)

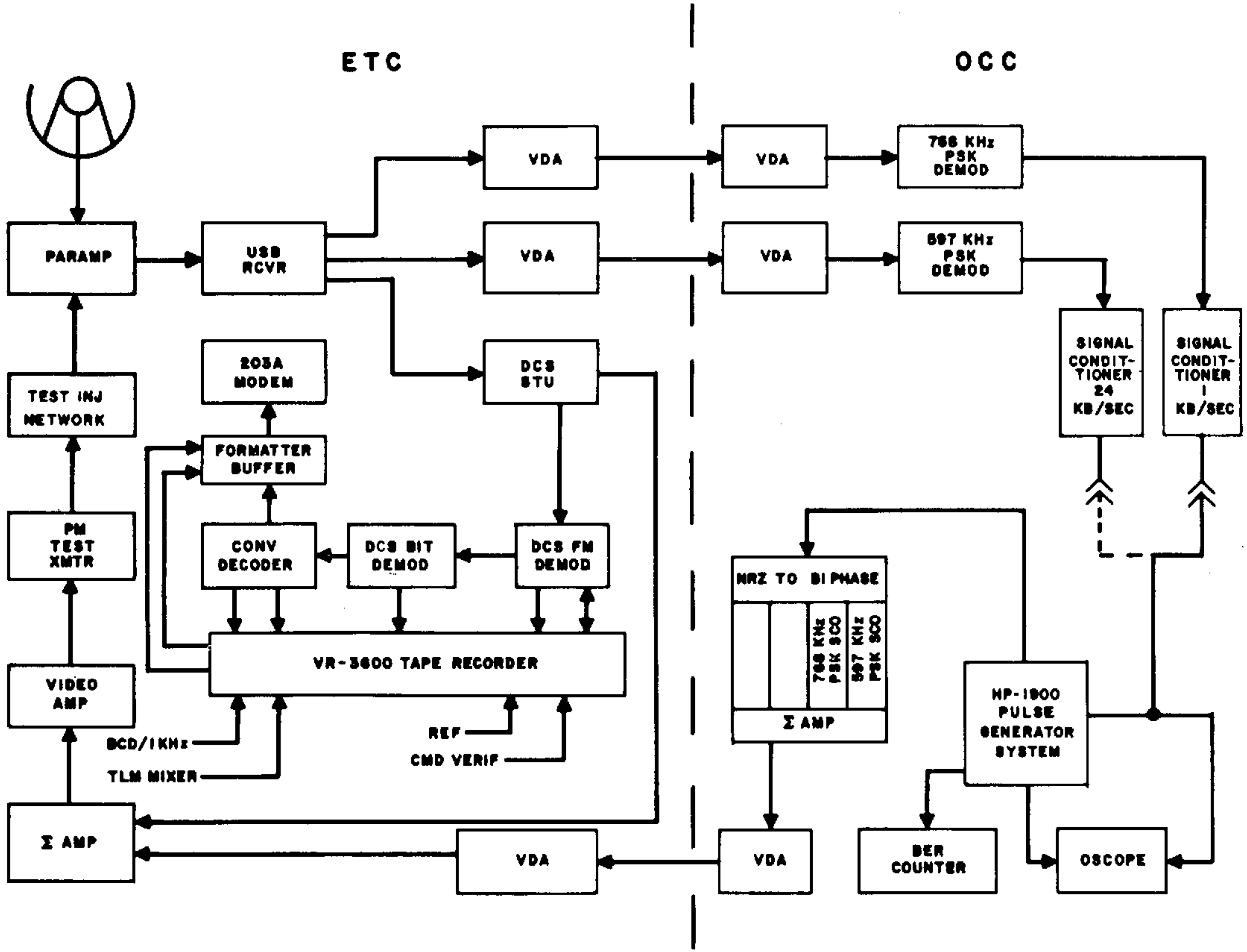


Figure 2-10. S-band PM Downlink Test Configuration (ETC/OCC)

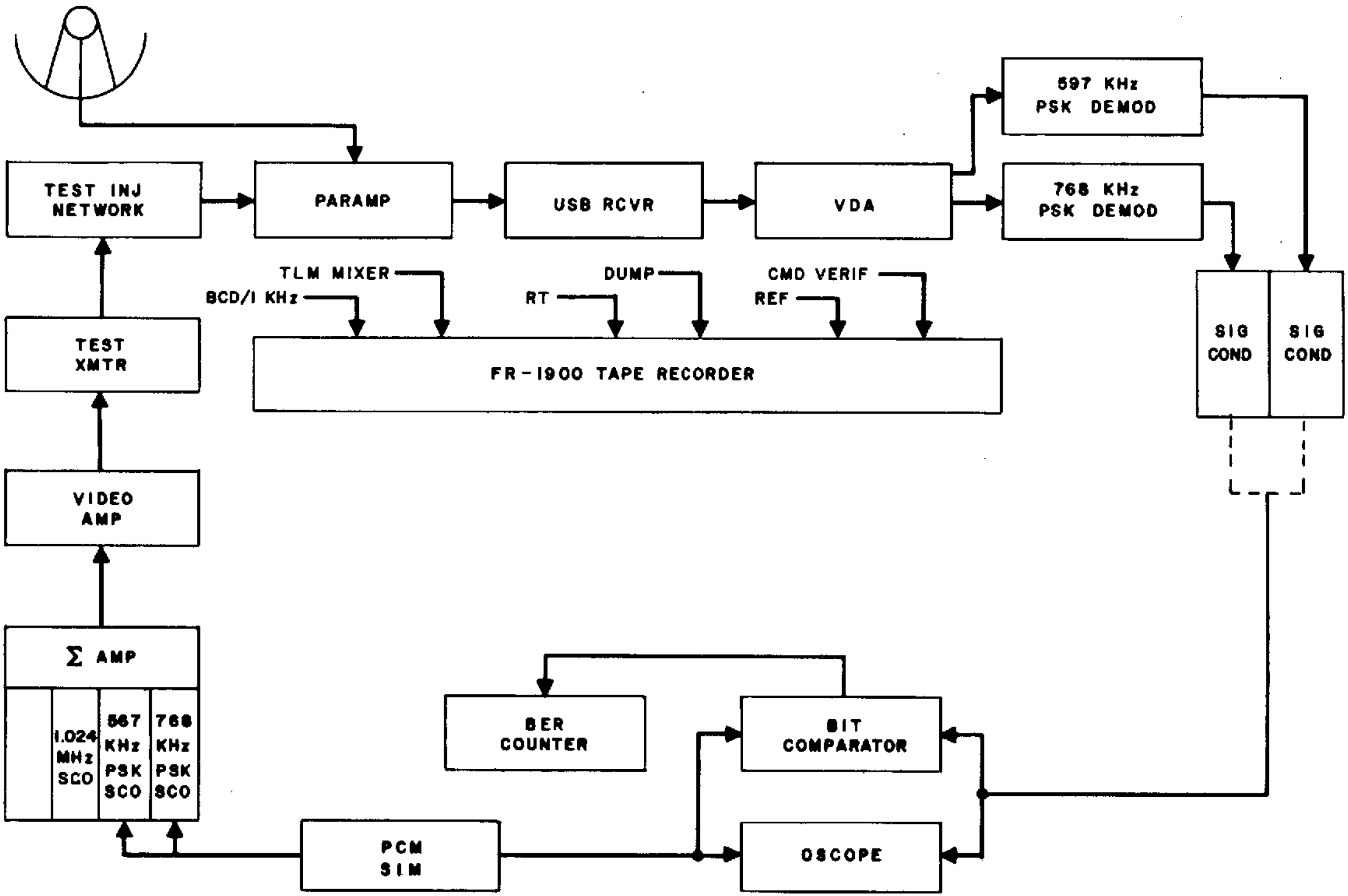


Figure 2-11. S-band PM Downlink Test Configuration (USB Backup)

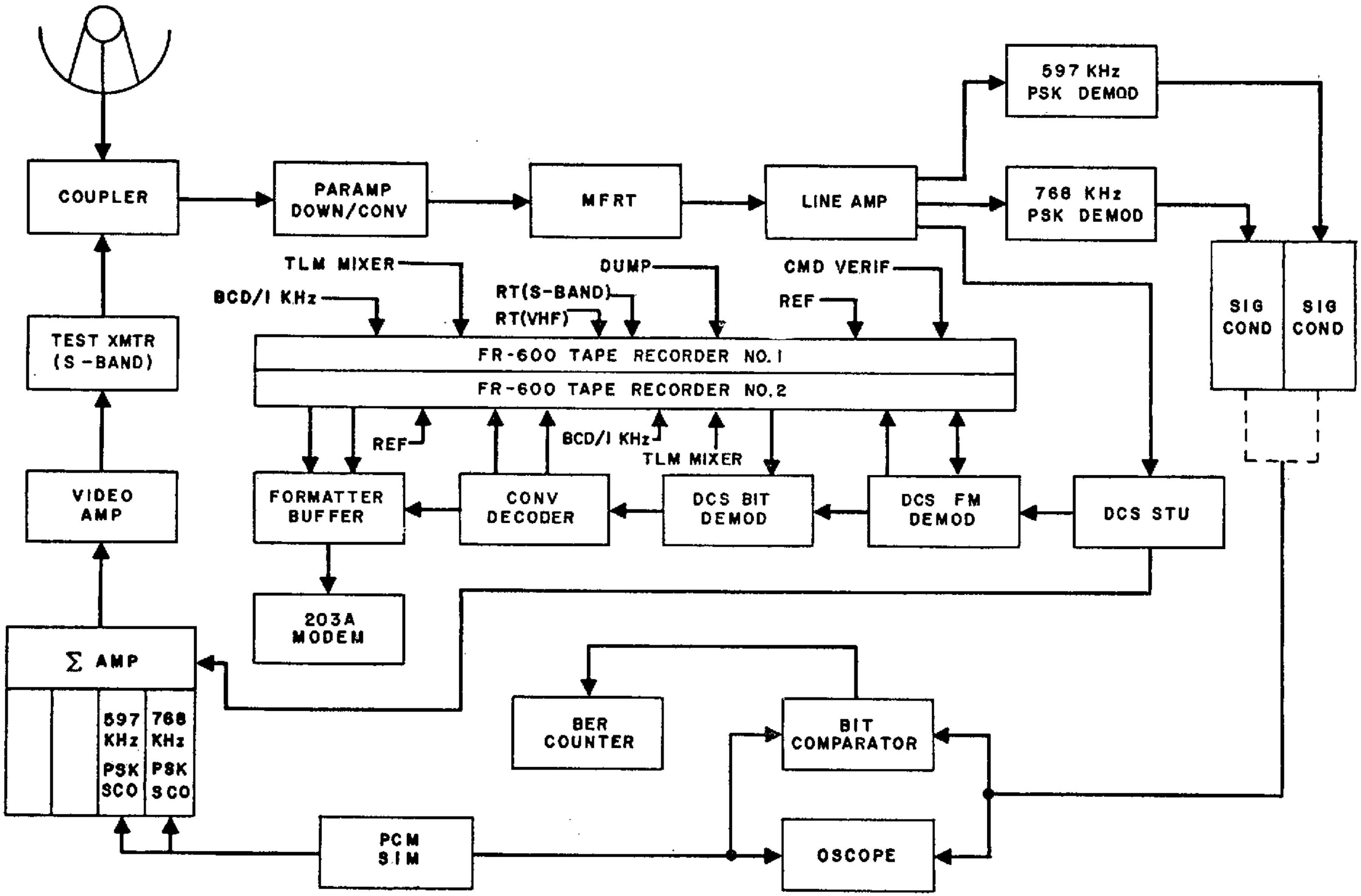

COUPLER
PARAMP DOWN/CONV
MFRT
LINE AMP
597 KHz PSK DEMOD
768 KHz PSK DEMOD
SIG COND
SIG COND
TEST XMTR (S-BAND)
VIDEO AMP
Σ AMP
597 KHz PSK SCO
768 KHz PSK SCO
TLM MIXER
BCD/I KHz
RT(S-BAND)
RT(VHF)
DUMP
CMD VERIF
REF
FR-600 TAPE RECORDER NO. 1
FR-600 TAPE RECORDER NO. 2
REF
BCD/I KHz
TLM MIXER
FORMATTER BUFFER
CONV DECODER
DCS BIT DEMOD
DCS FM DEMOD
DCS STU
203A MODEM
BER COUNTER
BIT COMPARATOR
OSCOPE
PCM SIM

Table 2-2. PM Downlink Test Parameters

Parameter/Equipment	Value/Setting
S-band Carrier Frequency	2287.5 MHz
Total Carrier Suppression	4.0 dB
USB RCVR Parameters	Per NOSP (STDN 601/ERTS)
Mfr RCVR Parameters	Per NOSP (STDN 601/ERTS)
PSK S/C Discriminators	Per NOSP (STDN 601/ERTS)
Signal Conditioner	Per NOSP (STDN 601/ERTS)
PCM Simulator	Per Appendix E
Bit Comparator	Per Appendix E
Bit Error Counter	Per Appendix E
PSK Simulator	Per Appendix E

Table 2-3. DCS Equipment Test Settings

Equipment	Control/Switch	Indication
FM demod	AUTO/MANUAL	AUTO
	PLAYBACK	OFF
	CHANNEL STATUS	SELECT 1, 2, 3, 4, 5, 6
	INHIBIT	OFF
Bit demod	INPUT SOURCE	RECEIVER
Conv. decoder	MODE	OPERATE
	AUTO HALT/FREE RUN	FREE RUN
Self-test unit	VCO AUTO/MAN	AUTO
	VCO ON/OFF	ON
	NOISE ON/OFF	ON
	C/KT ADJUST	+3
	MODE SEL	TEST
	STU/RECEIVER	RECEIVER
	RUN/HOLD	RUN
	MESSAGE SEL	$\overline{\text{PRN}}$
	TIME DELAY	6 MSEC
	DISPLAY	OFF
Formatter buffer	DATA SOURCE	DECODER
	REQUEST TO SEND	ON
	HEADER SOURCE	
	Alaska	367
	Goldstone	260
	NTTF	130
	DESTINATION CODE	177
	DATA FORMAT	156
	BURST/CONT.	BURST
	MASTER CLEAR	Press to Clear
Time code reader	POLARITY	+ (Plus)
	FWD/REV	FWD
	CODE	N3

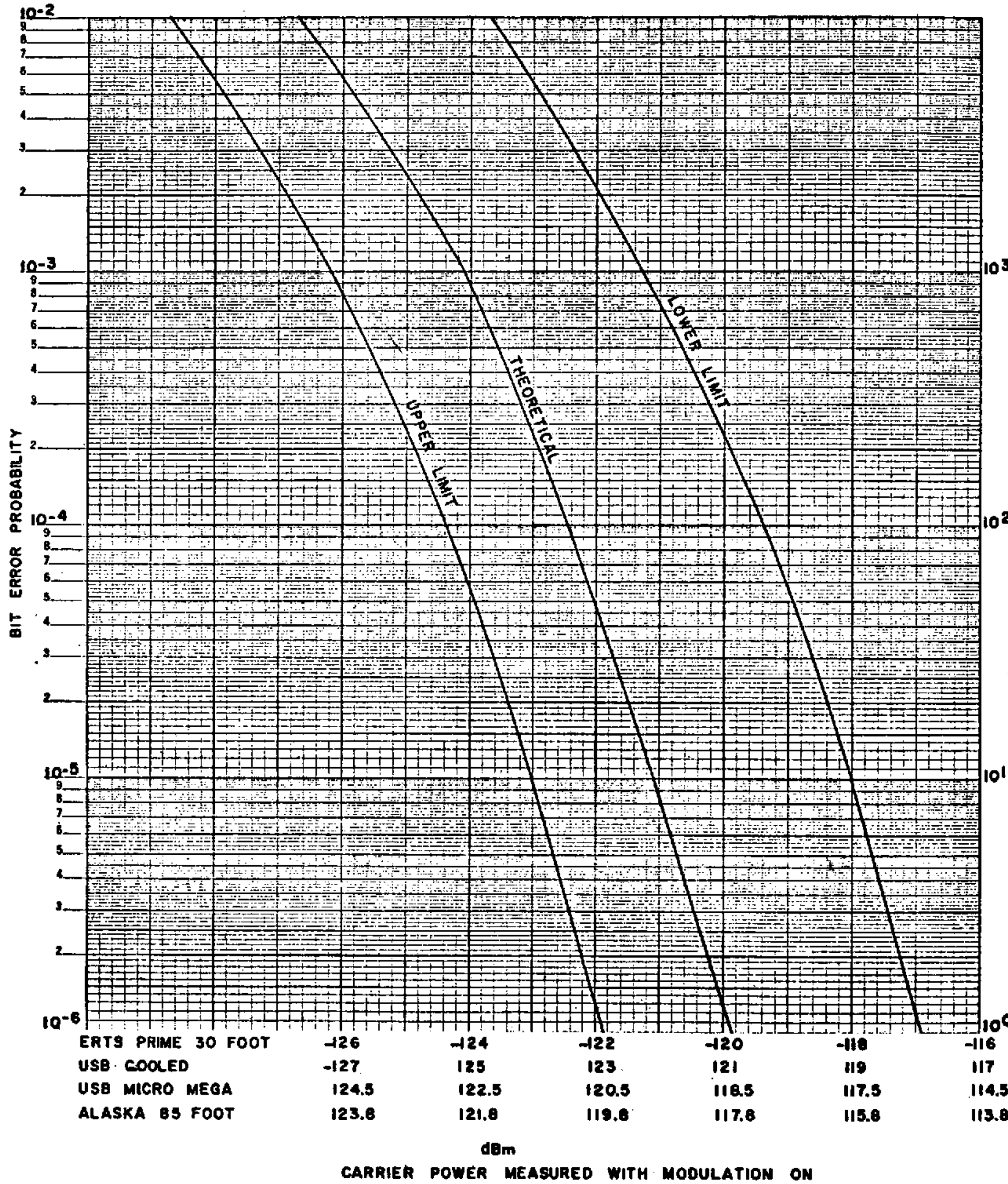


Figure 2-13. ERTS 1 kb/sec BER Test Criteria

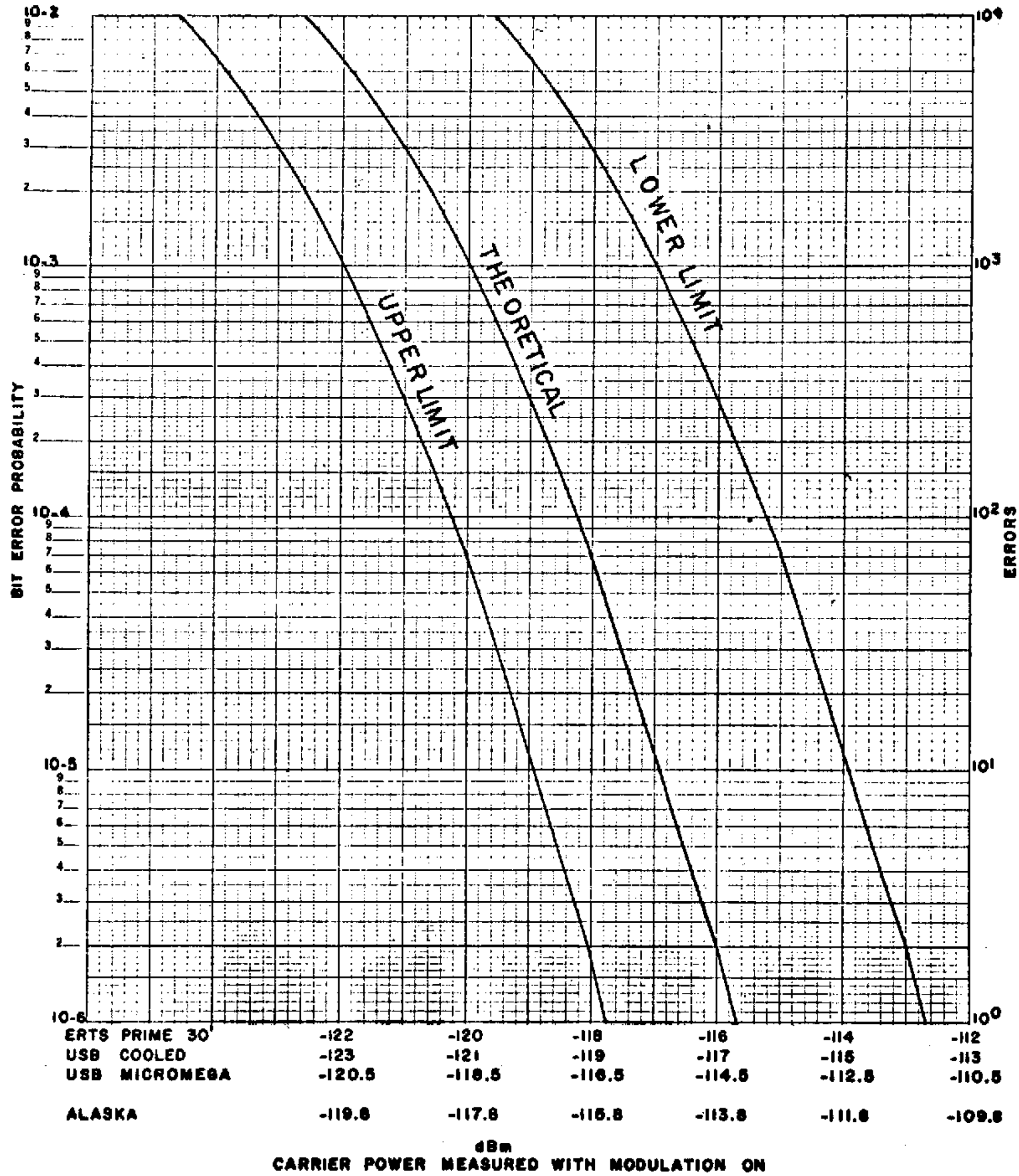


Figure 2-14. ERTS 24-kb/sec BER Test Criteria

2.6.2 VHF PM DOWNLINK DATA TEST

OBJECTIVE

The objective of this test is to verify the performance of the integrated system from the preamplifier input through postdetection of the data streams.

TEST DESCRIPTION

The test objective is accomplished by injecting a modulated calibrated test signal into the system and verifying system performance by the bit error rate.

2.6.2.1 Real-time 1-kb Data Test

a. Point the link 1 antenna to a known quiet point in the sky.

b. Configure the station as shown in figure 2-15 or 2-16.

c. Set the operating controls on the receiver/demodulator in accordance with STDN 601/ERTS.

d. Set up the PCM simulator with the ERTS-A program, or the PCM test program used in O&M Bulletin 147.

e. Set the simulator bit rate to 1 kb/sec.

f. Set the 136-MHz test injection signal generator to 137.86 MHz.

g. Use the Pulse Code Modulation (PCM) simulator signal to modulate the signal generator to a modulation index of 1.14 radians. This corresponds to a reduction in carrier power of 8.2 dB. (Refer to Appendix E, para 1.)

h. Inject the output of the signal generator into the test injection system.

i. Set the output of the signal generator for an input level of -60 dBm into the preamplifier.

j. Adjust the time delay to acquire coincidence between the simulated PCM signal and the output of the PCM bit synchronizer. Note that zero errors are generated.

k. Invert the polarity of the simulated PCM signal and note that 100 percent errors are generated.

l. Return the polarity to normal, reset the counter, and verify that zero errors are generated.

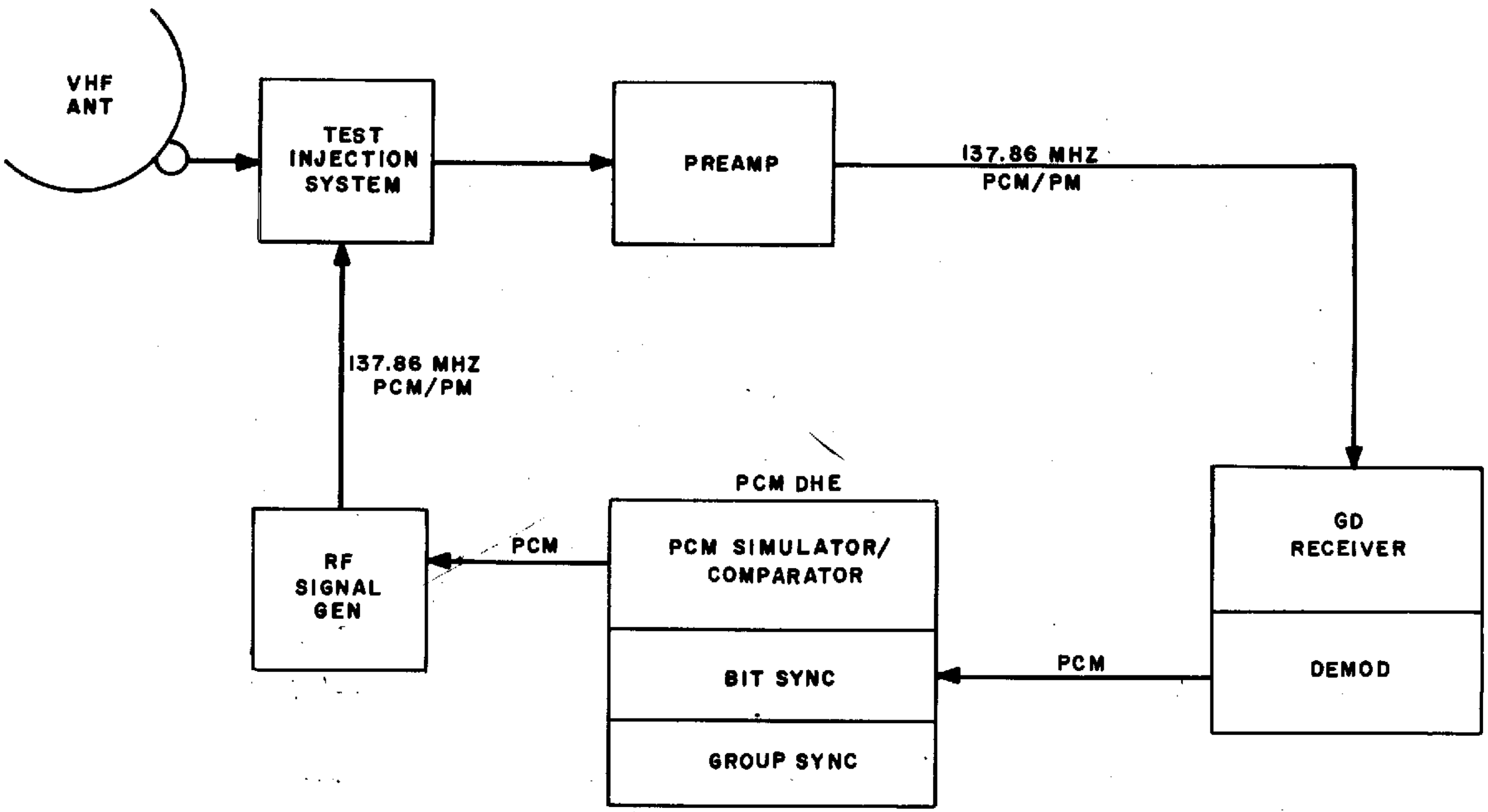


Figure 2-15. VHF Bit Error Rate Test (Using GD RCVR)

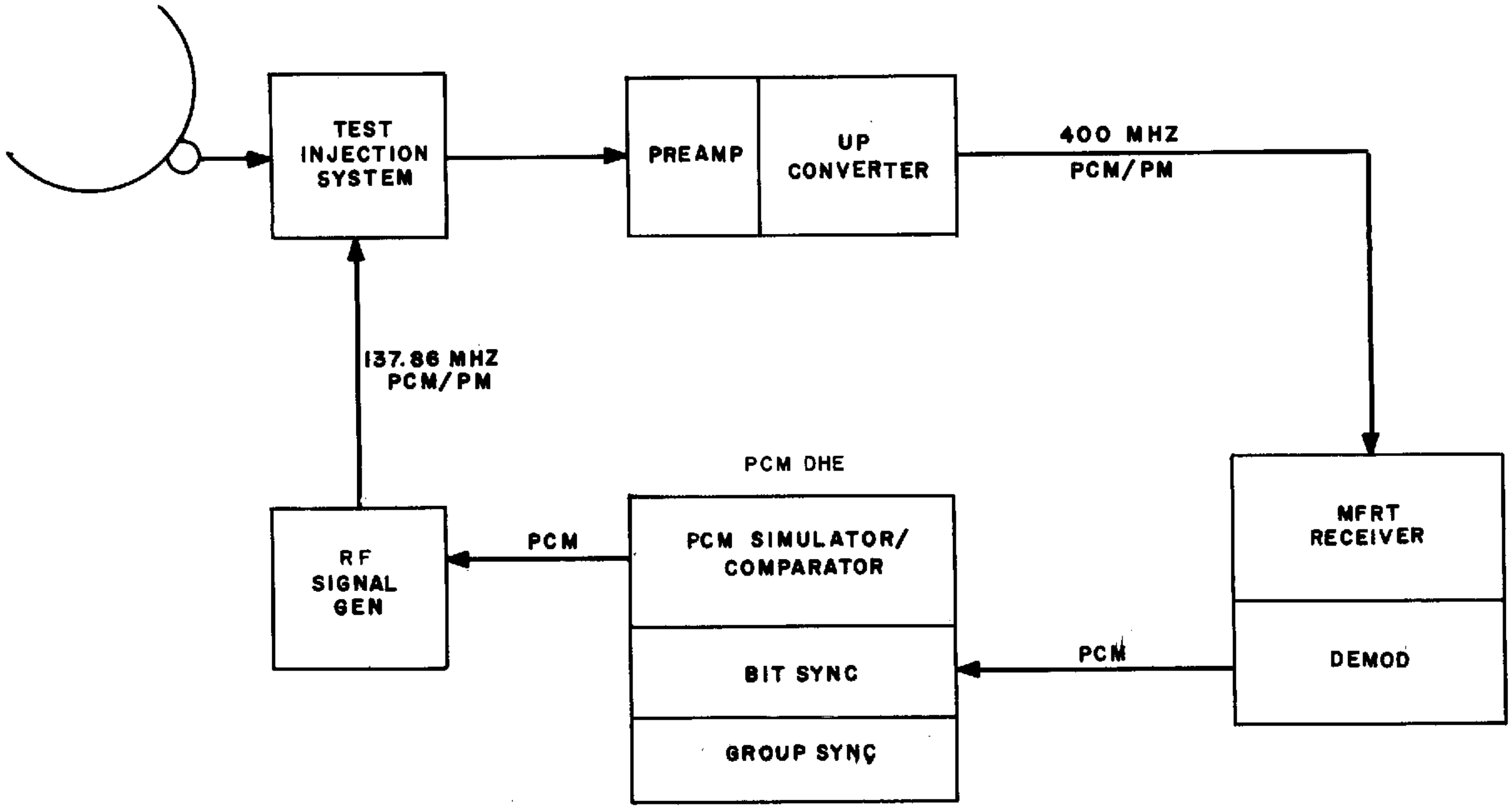


Figure 2-16. VHF Bit Error Rate Test (Using MFRT RCVR)

m. Adjust the output of the signal generator for an input level to the preamplifier of -133 dBm. Determine the bit error rate and compare the results with the graph on figure 2-17. Use the mean of not less than three samples. The Bit Error Rate (BER) graphs in figure 2-17 are based on the following assumptions.

(1) Thermal spectral noise power density is -169.6 dBm/Hz (at 290 degrees K)

(2) System noise temperature is +29 dB.

(3) -3 dB allowance (worst case curve) for tolerances, equipments, and measurements.

n. Increase the input power to the preamplifier to -131 dBm and determine the BER as described in para 2.6.2.1m.

o. Increase the input power to the preamplifier to -129 dBm and determine the BER as described in para 2.6.2.1m.

2.6.2.2 Dump 24-kb Data Test

a. Point the link 1 antenna to a known quiet point in the sky.

b. Configure the station as shown in figure 2-15 or 2-16.

c. Set the operating controls on the receiver/demodulator in accordance with STDN 601/ERTS.

d. Set up the PCM simulator with the ERTS-A program, or the PCM test program used in O&M Bulletin 147.

e. Set the simulator bit rate to 24 kb/sec.

f. Set the 136-MHz test injection signal generator to 137.86 MHz.

g. Use the PCM simulator signal to modulate the signal generator to a modulation index of 1.14 radians. This corresponds to a reduction in carrier power of 8.2 dB. (Refer to Appendix E, para 1.)

h. Inject the output of the signal generator into the test injection system.

i. Set the output of the signal generator for an input level of -60 dBm into the preamplifier.

j. Adjust the time delay to acquire coincidence between the simulated PCM signal and the output of the PCM bit synchronizer. Note that zero errors are generated.

k. Invert the polarity of the simulated PCM signal and note that 100 percent errors are generated.

l. Return the polarity to normal, reset the counter, and verify that zero errors are generated.

m. Adjust the output of the signal generator for an input level to the preamplifier of -121 dBm. Determine the bit error rate and compare the results with the graph on figure 2-17. Use the mean of not less than three samples. The BER graphs in figure 2-17 are based on the following assumptions:

(1) Thermal spectral noise power density is -169.6 dBm/Hz (at 290 degrees K).

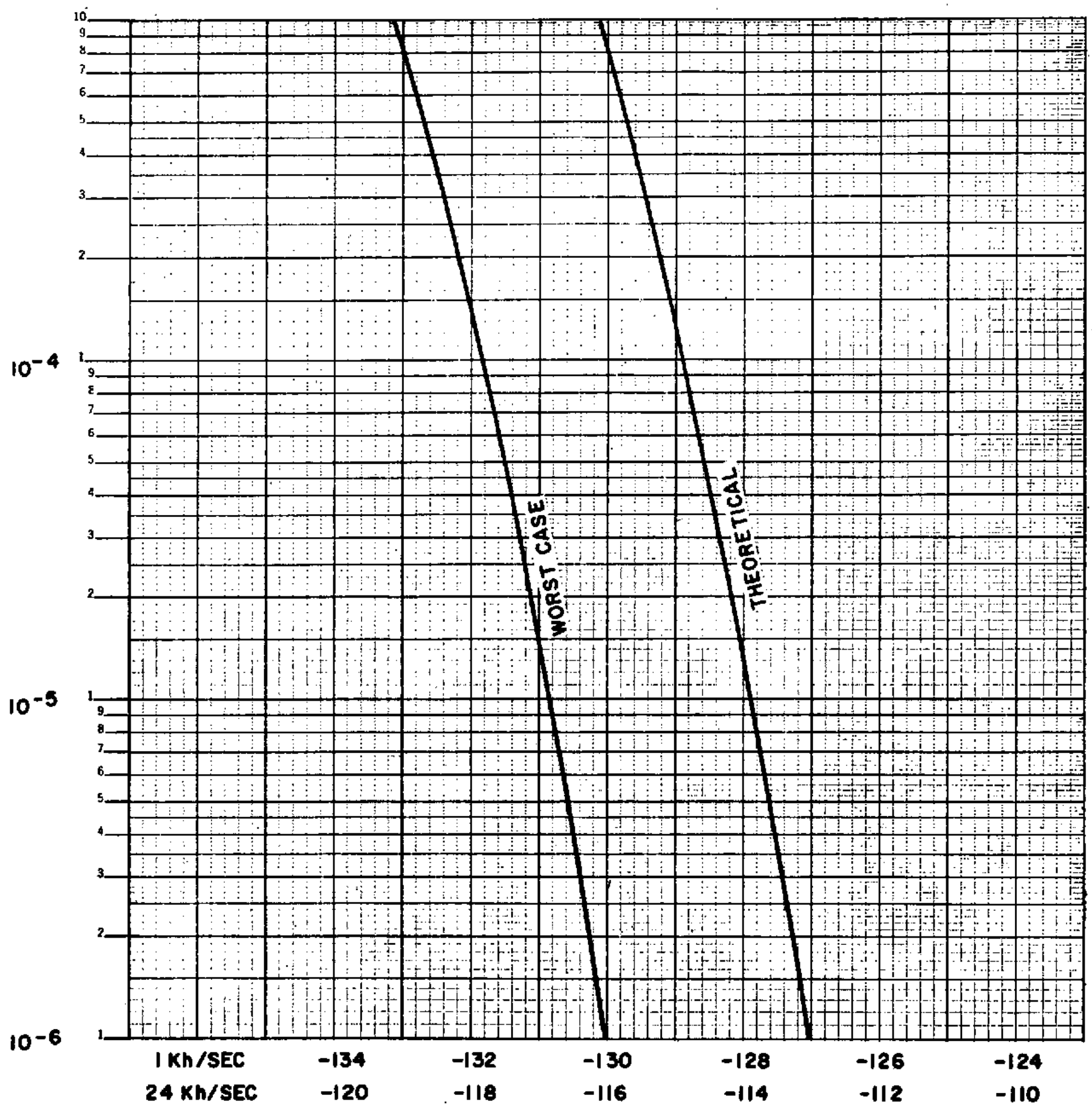


Figure 2-17. Bit Error Rate as a Function of Signal Level

(2) System noise temperature is +29 dB.

(3) -3 dB allowance (worst case curve) for tolerances, equipment, and measurements.

n. Increase the input power to the preamplifier to -119 dBm and determine the BER as described in para 2.6.2.2m.

o. Increase the input power to the preamplifier to -117 dBm and determine the BER as described in para 2.6.2.2m.

2.7 MSS FM DOWNLINK TEST

OBJECTIVE

The objective of this test is to verify that the integrated systems performance from the parametric amplifier input through post-detection and recording of the data is capable of supporting the Earth Resources Technology Satellite (ERTS) mission.

TEST DESCRIPTION

The test objective is accomplished by modulating the Frequency Modulation (FM) test transmitter with simulated mission data and injecting the test transmitter output into the parametric amplifier. Post-detection analysis of the detected and recorded data is performed to verify systems performance.

2.7.1 GENERAL

2.7.1.1 The ETC ERTS station will coordinate this test with the ERTS OCC since all detection and simulation equipments are physically located at the ERTS OCC. ERTS OCC ground station personnel will perform the MSS and RCDR operator functions of this test.

2.7.1.2 The ETC ERTS station test conductor (TC) is the coordinator for this test and will require MSS data support from the ERTS OCC.

2.7.1.3 Unified S-band (USB) sites will utilize the Microdyne Model 7100 test transmitter in the performance of this test. Alaska (ULA) will utilize the Radiation System, Inc., Calibration Signal Generator as the test transmitter. The modulation index of the test transmitter should be established utilizing Appendix A and verified by measuring the wideband demodulator output (wideband demod output Vpp times wideband demod sensitivity MHz/volt = peak-to-peak deviation).

2.7.1.4 Bit error rate test criteria included in this test (see figures 2-18 and 2-19) are included for information only. Stations will be provided with the test equipment and procedures for performing the bit error rate test at a future date.

2.7.2 TEST PROCEDURES

Use the following sequences to complete the MSS FM Downlink Test.

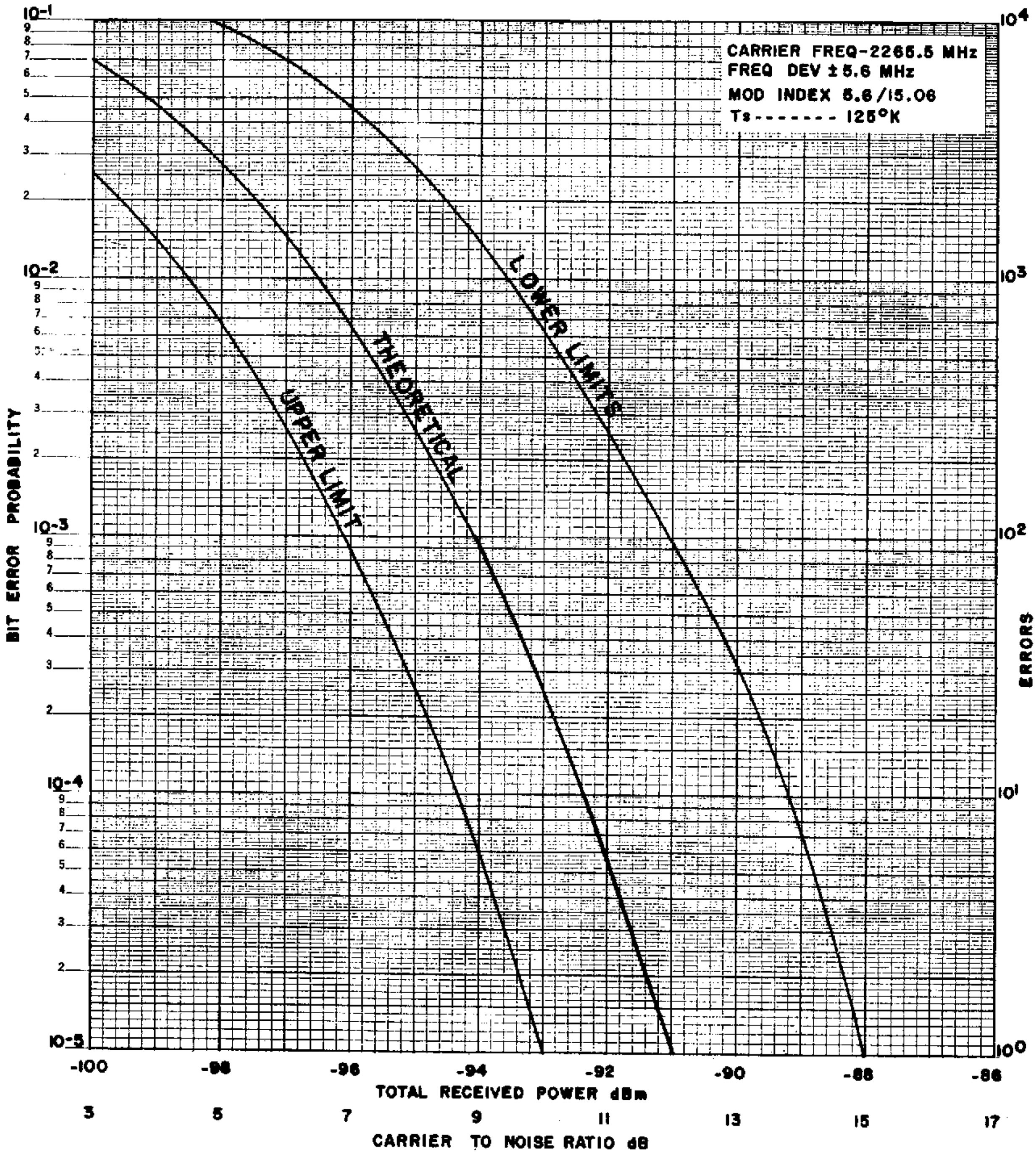


Figure 2-18. MSS Test Criteria (ENT and EGD)

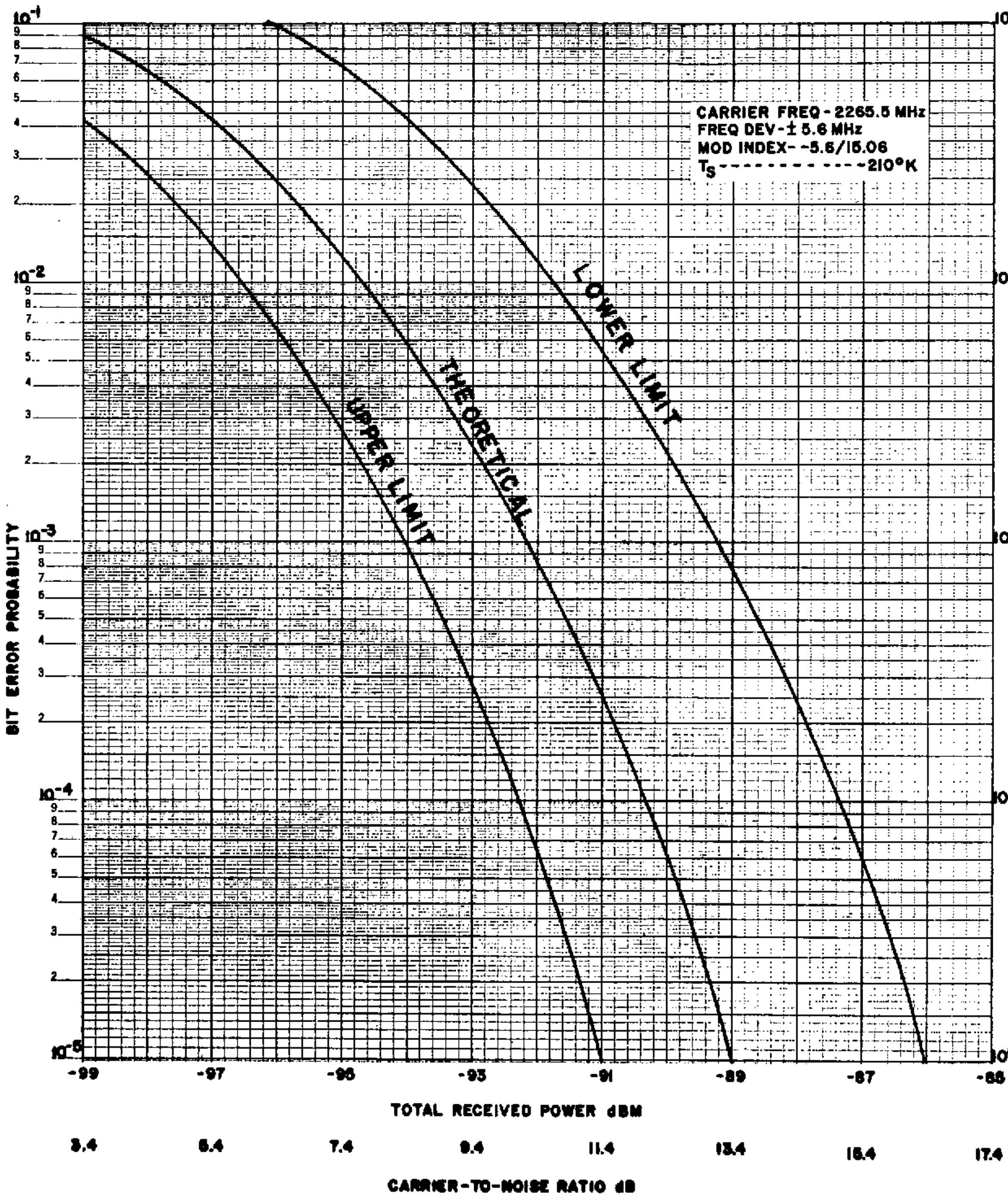


Figure 2-19. MSS Test Criteria (ULA)

MSS FM Downlink Test

<table>
<tr><th>Seq</th><th>Test</th><th>Operator</th><th>Instructions</th></tr>
<tr><td>1</td><td>MNFS Errors</td><td>USB/MFR/MSS/ RCDR*</td><td>Configure the station equipment as shown in figure 2-20, 2-21, or 2-22 as applicable. Set equipment parameters as given in table 2-4.</td></tr>
<tr><td>2</td><td>MNFS Errors</td><td>USB/MFR/MSS*</td><td>Set up the MSS test set to simulate the downlink 15.06-Mb/sec NRZ bit stream. Set the MSS test set 15.06-Mb/sec output to deviate the test transmitter ±5.6 MHz. The test transmitter deviation should be established using the modulation sensitivity determined by the method of Appendix A.

Note

ETC ERTS station personnel should verify optimum reception of the MSS 15.06 Mb/sec data from the ERTS OCC prior to setting the test transmitter deviation.</td></tr>
<tr><td>3</td><td>MNFS Errors</td><td>MSS*</td><td>At the bit synchronizer, verify that the SYNC indicator is illuminated and that the DATA indicator is extinguished.</td></tr>
<tr><td>4</td><td>MNFS Errors</td><td>MSS*</td><td>Set the MSS test set as follows:
<table>
<tr><th>Switch</th><th>Setting</th><th>Switch</th><th>Setting</th></tr>
<tr><td>5-10 Preamble</td><td>10</td><td>General Word</td><td>011111</td></tr>
<tr><td>6-7 Good Pre</td><td>7</td><td>Start Scan Sync</td><td>111000</td></tr>
<tr><td>Miss 3-4 Pre</td><td>3</td><td>MNFS Word</td><td>001011</td></tr>
<tr><td>∿-DC</td><td>DC</td><td>Preamble Word</td><td>000111</td></tr>
<tr><td>Unique Sens Sel</td><td>1</td><td>All White</td><td>NORM</td></tr>
<tr><td>MNFS Word Misses</td><td>0</td><td>All Black</td><td>NORM</td></tr>
<tr><td>First Word after SSSC</td><td>NORM</td><td>Clock Source</td><td>INT.</td></tr>
<tr><td>Miss All MNFS Words</td><td>NORM</td><td>Error Word Code</td><td>000000</td></tr>
<tr><td>Unique Word</td><td>011111</td><td>Sensor Channel Sel</td><td>1</td></tr>
<tr><td>Tape-DEMUX PBI</td><td>Tape</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>5</td><td>MNFS Errors</td><td>USB/MFR</td><td>Set the test transmitter output for a -88 dBm signal (ULA use -86 dBm) level into the parametric amplifier.</td></tr>
</table>

*For NTE testing, the MSS operator is located at the OCC.

MSS FM Downlink Test (cont)

Seq	Test	Operator	Instructions
6	MNFS Errors	MSS*	Verify that the demultiplexer PREAMBLE SEARCH, PREAMBLE LOCK, and MNFS LOCK indicators are blinking. Connect a frequency counter to demultiplexer J-44. Set the counter FUNCTION switch to FREQUENCY and the TIME BASE switch to 10 SEC.
7	MNFS Errors	MSS*	Record the error count as displayed on the frequency counter. The error count as measured on the frequency counter should not exceed 3 errors per 10 seconds. Disconnect the frequency counter from J-44.
8	MNFS	MSS*	Set the test set MNFS WORD MISSES switch to MISS 3 and verify that the demultiplexer MINOR FRAME LOCK indicator remains blinking.
9	MNFS	MSS*	Set the test set MNFS WORD MISSES switch to NORM and the MISS 4 MNFS WORDS. Verify that the demultiplexer MINOR FRAME SEARCH indicator is blinking and the MINOR FRAME LOCK indicator is extinguished.
10	MNFS	MSS*	Set the test set MNFS WORD MISSES switch to 0 and the MISS ALL MNFS WORDS switch to ALL. Verify that the demultiplexer MINOR FRAME SEARCH indicator is blinking and the MINOR FRAME LOCK indicator is extinguished. Return MISS ALL MNFS WORDS switch to NORM.
11	Pre-amble	MSS*	Set the test set 5-10 MS PREAMBLE switch to 10 and the MISS 3 or 4 PREAMBLE WORDS switch to 4. Verify that the demultiplexer MINOR FRAME SEARCH and LOCK indicators are extinguished. Return MISS 3 or 4 PREAMBLE WORDS switch to 3.
12	Pre-amble	MSS*	Set the test set 5-10 MS PREAMBLE switch to 5 and 6 or the 7 GOOD PREAMBLE WORDS switch to 6. Verify that the demultiplexer PREAMBLE LOCK, MINOR FRAME SEARCH, and MINOR FRAME LOCK indicators are extinguished. Return the 6 or 7 GOOD PRE-AMBLE WORDS switch to 7 and the 5-10 MS PREAMBLE switch to 10.

*For NTE testing, the MSS operator is located at the OCC.

MSS FM Downlink Test (cont)

Seq	Test	Operator	Instructions
13	Time Interval	RCDR *	Set up the FR-1928 magnetic tape recorder for mission support as specified in the Network Operations Support Plan for the Earth Resources Technology Satellite (ERTS), STDN No. 601/ERTS. Verify correct level at each recorder input. Install a clean degaussed scratch tape on the FR-1928 transport. Start the tape recorder in a simultaneous RECORD-REPRODUCE mode.
14	Time Interval	MSS/RCDR*	Verify that the test set TIME INTERVAL MEASUREMENT display indicates 010 011 000 000 000 111.
15	Time Interval	MSS/RCDR*	Set the ALL BLACK CODE switch to 15 and the ALL WHITE CODE switch to 3. Verify that the TIME INTERVAL MEASUREMENT display indicates 010 011 000 000 000 111.
16	Time Interval	MSS/RCDR*	Set the test set ALL WHITE CODE switch to NORMAL. Verify that the TIME INTERVAL MEASUREMENT display indicates 010 011 000 000 000 111.
17	Time Interval	MSS/RCDR*	Set the test set ALL BLACK CODE switch to 14 and the ALL WHITE CODE switch to 3. Verify that the TIME INTERVAL MEASUREMENT display indicates 010 011 000 000 000 111.
18	Time Interval	MSS/RCDR*	Set the 5-10 MS PREAMBLE switch to 5 and repeat sequences 13 through 16. The TIME INTERVAL MEASUREMENT display should indicate 010 100 111 111 111 000 in each sequence.
19	Time Interval	MSS/RCDR *	Set the test set ALL BLACK CODE switch to 14 and the ALL WHITE CODE switch to 2. Verify that the TIME INTERVAL MEASUREMENT display indicates 111 111 111 111 111 111.

*For NTE testing, the MSS and RCDR operators are located at the OCC.

MSS FM Downlink Test (cont)

Seq	Test	Operator	Instructions
20	Time Interval	MSS/RCDR*	Set the ALL BLACK CODE switch to 15 and the ALL WHITE CODE switch to 2B1. Verify that the TIME INTERVAL MEASUREMENT display indicates 111 111 111 111 111 111. Reset the ALL BLACK CODE and ALL WHITE CODE switches to NORMAL.
21	RCD/ REP	MSS/RCDR*	Set the MSS test $\wedge\wedge$ -DC switch to $\wedge\wedge$ -UNIQUE and select the test set output to be displayed on the status monitor oscilloscope.
22	RCD/ REP	MSS/RCDR*	Verify a 5-Vpp triangular wave as displayed on the status monitor oscilloscope. The triangular waveform should be linear and noise free with a period of approximately 1.3 milliseconds.
23	RCD/ REP	MSS/RCDR*	Set the MSS test set UNIQUE SENSOR SELECT and SENSOR CHANNEL SELECT switches to channel 2. Repeat sequence 22.
24	RCD/ REP	MSS/RCDR*	Repeat sequences 22 and 23 for positions 3 through 26 of the UNIQUE SENSOR SELECT and SENSOR CHANNEL SELECT switches. Note The period of the triangular waveform will be approximately 3.8 milliseconds for channels 25 and 26.
25	RCD/ REP	MSS/RCDR*	Stop the FR-1928 recorder, remove the test tape from the transport, and install the mission support tape.

*For NTE testing, the MSS and RCDR operators are located at the OCC.

MSS FM Downlink Test (cont)

Seq	Test	Operator	Instructions
			Note Perform sequences 26 through 30 only if the TR-70 video recorder is scheduled for MSS support.
26	RCD	MSS/RCDR*	Configure the TR-70 video tape recorder for MSS support. Verify correct level of the 15.06-Mb/sec data and clock at the recorder input. Set the MSS test set ∿ -DC switch to DC.
27	RCD	MSS/RCDR*	Install a degaussed scratch tape on the TR-70 transport. Start the TR-70 and record 3 to 5 minutes of data on the tape. Rewind the tape to the beginning of the recorded data.
28	REP	MSS/RCDR*	Configure the TR-70 recorder toplay back the recorded data into the MSS bit synchronizer. Set up the status monitor oscilloscope to monitor the demultiplexer. Set the demultiplexer CHANNEL SELECT switch to 1.
29	REP	MSS/RCDR*	Start the tape recorder in a reproduce mode and verify lock condition on the bit synchronizer and demultiplexer. Verify a 2.5-volt dc level on the status monitor oscilloscope for each position of the demultiplexer CHANNEL SELECT switch.
30	REP	MSS/RCDR*	Stop the tape recorder and remove the test tape. Reconfigure all equipment for mission support and install the mission tape.

*For NTE testing, the MSS and RCDR operators are located at the OCC.

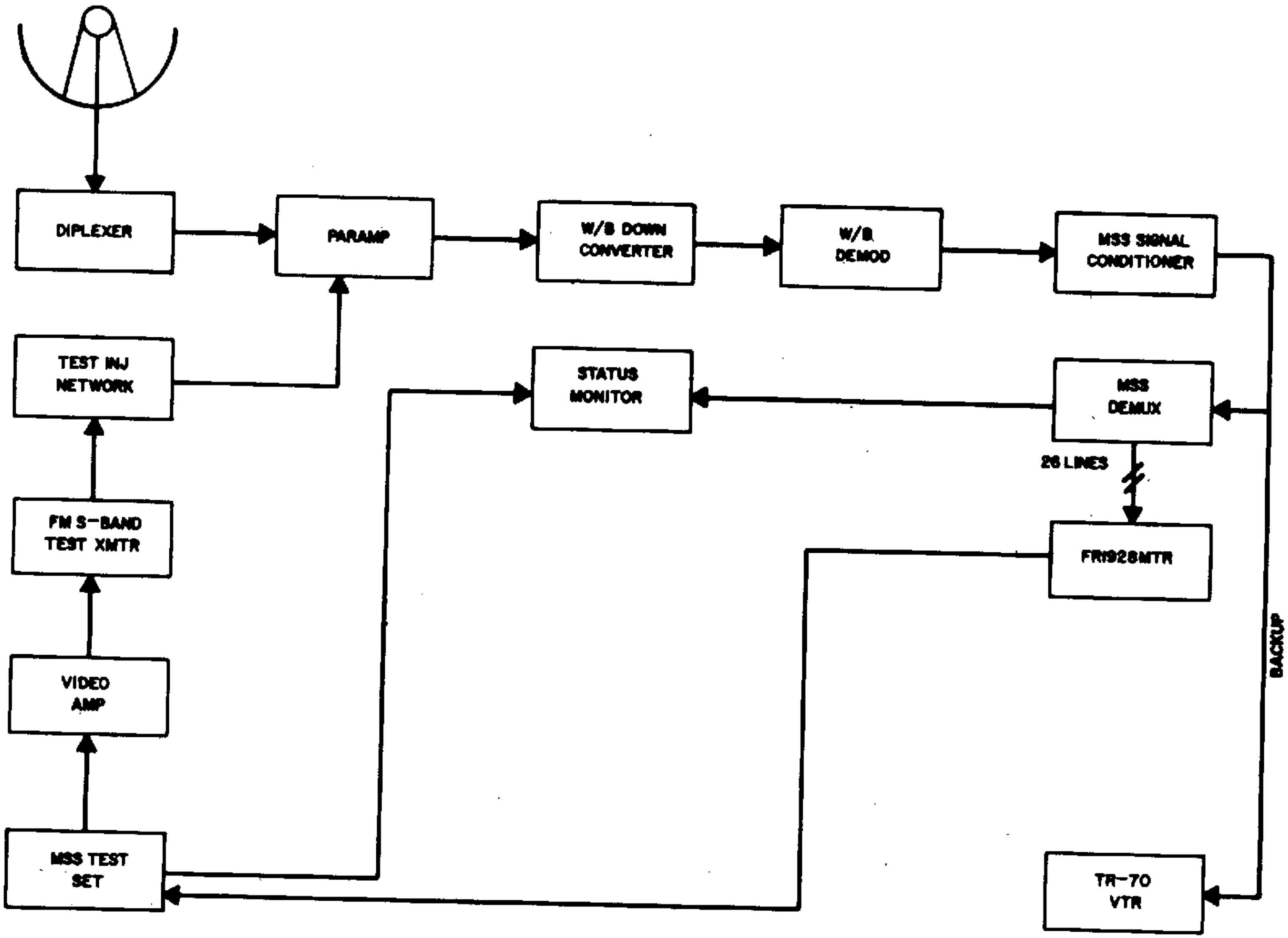


Figure 2-20. MSS Test Configuration (EGD)

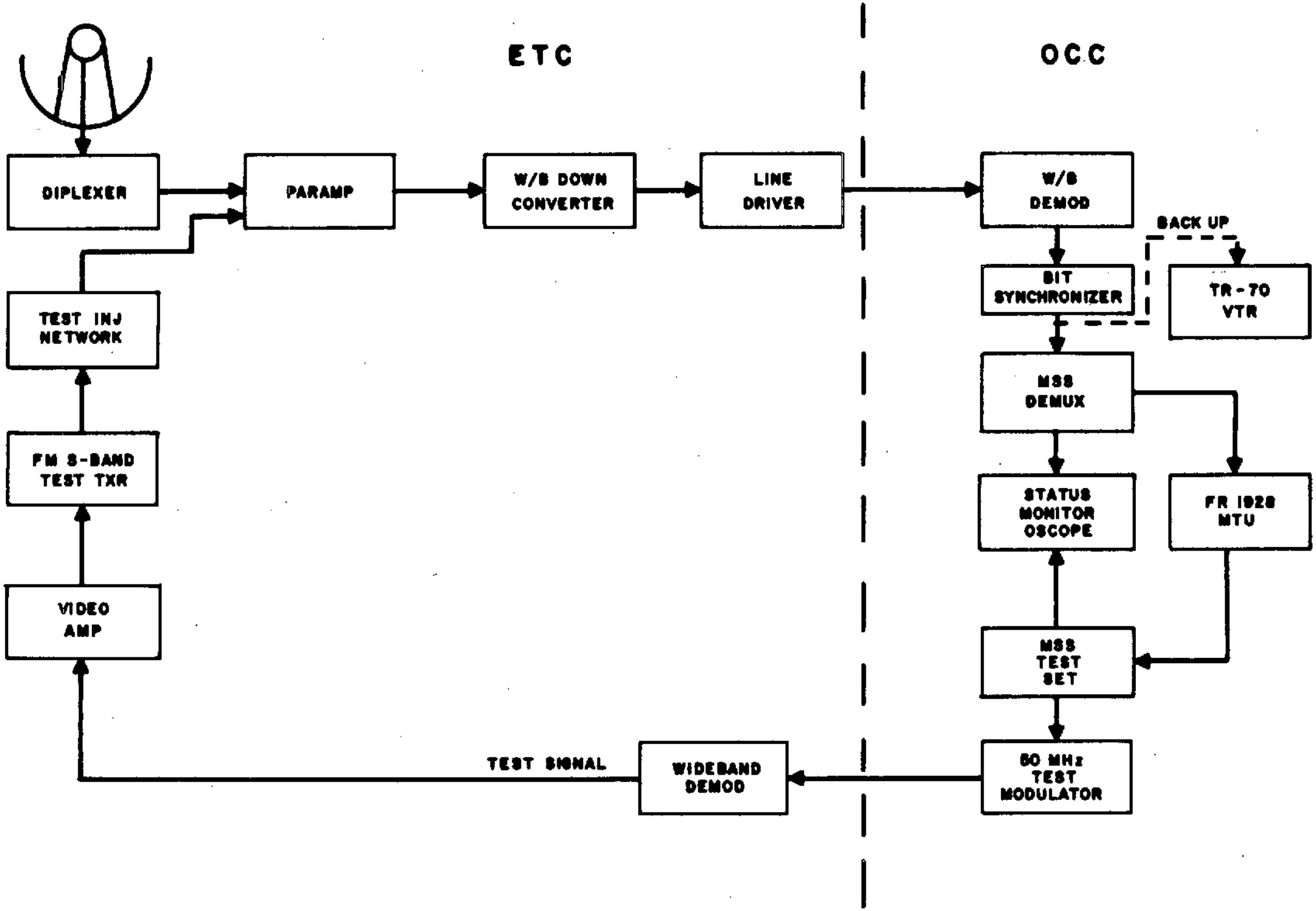


Figure 2-21. MSS Test Configuration ETC/OCC

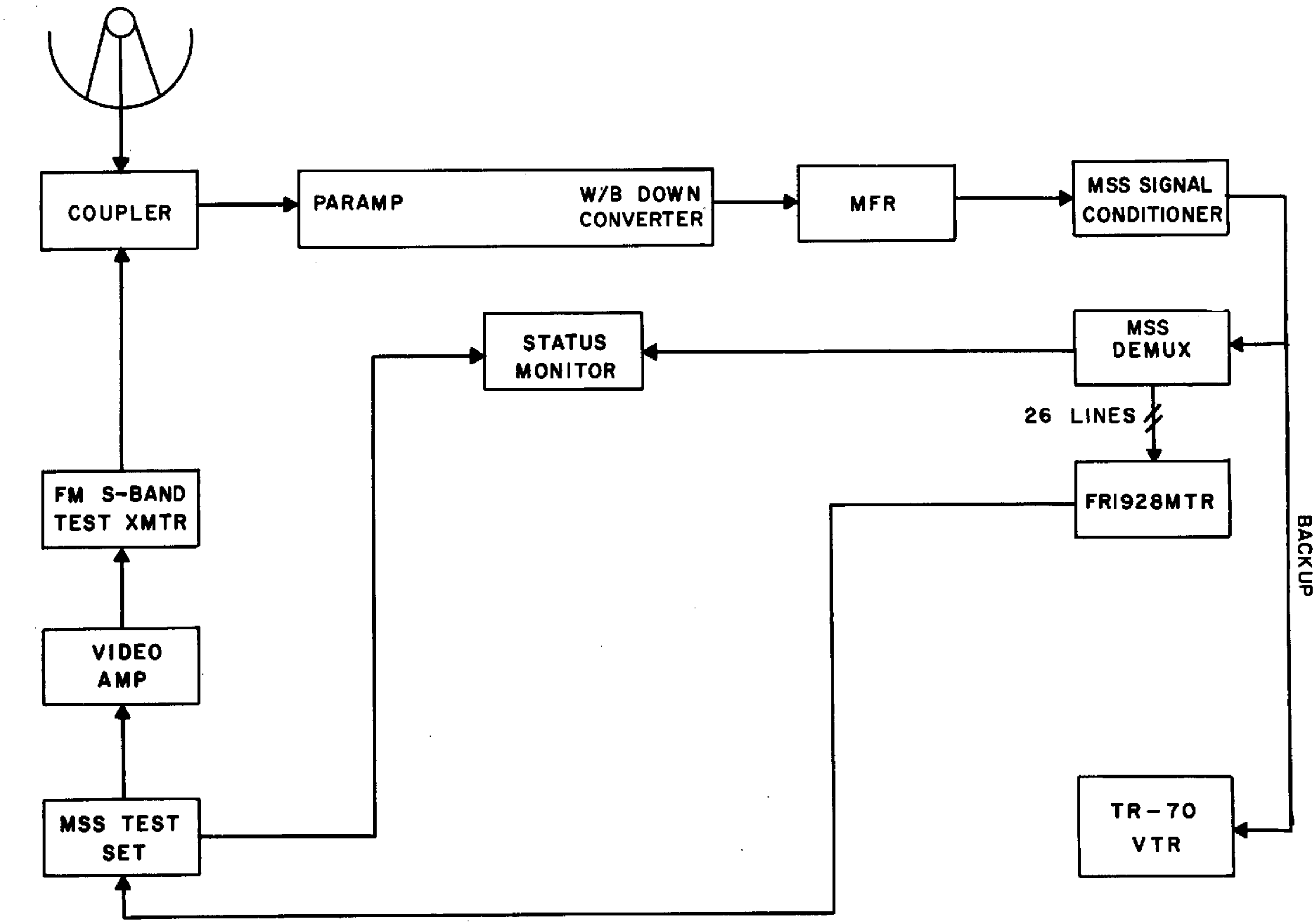


Figure 2-22. MSS Test Configuration (ULA)

Table 2-4. Equipment Setup

Equipment	Parameter	Setting/Indication
Test Transmitter	Frequency Deviation Output level	2265.5 MHz ±5.6 MHz -80 dBm
Wideband Downconverter	Frequency Bandwidth	2265.5 MHz 30.0 MHz
Wideband Demodulator *	Input bandwidth Mode Video bandwidth Video output level	20 MHz LOCAL 10 MHz 5.6 Vpp
Multi-function receiver	Band select Channel select IF bandwidth Mode select Video bandwidth Video output level Tuning mode Tracking BW AGC speed	2200 MHz 465.5 MHz 20 MHz FM 10 MHz 3.9 Vpp OPEN LOOP 300 Hz 30 MS
Bit Synchronizer *	Source Polarity Bandwidth	FM demod (1) Normal 2
Demultiplexer *	Data phase Delay IN-OUT PBI Start of scan code	Normal OUT PRMBL + SMCI + MNFS

*For NTE testing the above equipment is located at the OCC

2.8 RBV FM DOWNLINK TEST

OBJECTIVE

The objective of this test is to verify the performance of the integrated systems from the parametric amplifier input through the post-detection of the video data.

TEST DESCRIPTION

The test objective is accomplished by modulating the FM test transmitter with the video output of the Test Pattern Generator (TPG). The output of the test transmitter is injected into the parametric amplifier and post-detection signal-to-noise and video quality are measured.

2.8.1 GENERAL

2.8.1.1 The ETC ERTS station will coordinate this test with the ERTS OCC since all detection and simulation equipments are physically located at the ERTS OCC. ERTS OCC ground station personnel will perform the RBV and TR-70 operator functions of this test.

2.8.1.2 The ETC station test conductor (TC) is the coordinator for this test and will require RBV data support from the ERTS OCC.

2.8.1.3 Unified S-band (USB) sites will utilize the Microdyne Model 7100 test transmitter in the performance of this test. Alaska will utilize the Radiation Systems, Inc. Calibration Signal Generator as the test transmitter. The modulation index of the test transmitter should be established utilizing Appendix A and verified by measuring the demod output (wideband demod output Vpp times demod sensitivity MHz/volt = peak-to-peak deviation).

2.8.1.4 Care should be exercised throughout the performance of this test to maintain impedance match. When tee connectors are installed to facilitate measurements, high-impedance test instruments should be used to avoid mismatch. When measurements are made at unused connections or test points, high-impedance instruments should be used with unused systems connections terminated in the specified characteristic impedance.

2.8.2 TEST PROCEDURES

Use the following test sequences to perform this test:

RBV FM Downlink Test

Seq	Test	Operator	Instructions
1		RBV/RCDR/ USB/MFR	Note For ETC testing, the RBV and RCDR operators are located at the ERTS OCC. Configure the station as shown in figure 2-23, 2-24, or 2-25 as applicable. Set applicable equipment parameters as specified in table 2-5.
2	S:N	USB/MFR/RBV	Set the test transmitter output attenuator for a -85 dBm level into the parametric amplifier. Set the RBV TPG for a horizontal burst test pattern (20) output to modulate the test transmitter ±5.6 MHz. Note ETC ERTS station personnel should verify optimum reception of the RBV video data from the ERTS OCC prior to setting the test transmitter deviation. The test transmitter deviation should be established using modulation sensitivity determined by the method of Appendix A. Select FM receiver input to the VPASS and verify VPASS PLL lock. Verify correct indication and sequencing of all VPASS front panel indicators.
3	S:N	RBV	Connect an oscilloscope to RBV patch panel J-23. Measure the video output peak-to-peak amplitude, sync tip dc level, black reference dc level, and white reference level. Verify that the measured data meets the test criteria of item 1, table 2-6.
4	S:N	RBV/USB/MFR	Remove the modulation from the test transmitter and disconnect the oscilloscope from J-23. Connect the HP-3403A true RMS voltmeter to RBV patch panel J-23, and measure the rms noise output.
5	S:N	RBV	Utilizing the data of sequences 3 and 4, calculate the peak-to-peak signal/rms noise ratio. Verify that the VPASS output S:N (dB) meets the test criteria of item 2, table 2-6. Disconnect the HP-3403 true rms voltmeter from the J-23.
6	QLM	RBV	Reapply modulation to the test transmitter. Verify correct indication and sequencing of all VPASS front panel indicators. Verify correct operation of the Quick-look Monitor (QLM) and camera by photographing a signal frame of data and visually inspecting the photo.

RBV FM Downlink Test (cont)

Seq	Test	Operator	Instructions
7	Freq response	RBV	Connect the dual-channel oscilloscope to display the TPG output on channel A and the RBV patch panel J-23 on channel B. Adjust the oscilloscope controls for equal amplitude of the horizontal sync edge (sync tip to white reference levels) of the A and B displays.
8	Freq response	RBV	Compare the relative amplitudes of the channel A and channel B displays. The relative amplitudes of the channel A and B black references (50 kHz, 100 kHz, 200 kHz, 500 kHz, 1 MHz, and 3.2 MHz) should meet the test criteria of item 3 of table 2-6.
9	Freq response	RBV	Set the TPG pattern selector for a white level video test pattern (50) output. With the oscilloscope set up per sequence 7, verify the white level tilt meets the test criteria of item 4, table 2-6.
10	Linearity	RBV	Set the TPG for a $\sqrt{2}$ grey scale test pattern (01) output. With the oscilloscope set up per sequence 7, verify that the linearity of the channel B display meets the test criteria of item 5, table 2-6.
11	Record/Reproduce	RBV/TR-70	Set up the TR-70 video tape recorder for normal RBV operation as specified in STDN No. 601/ERTS. Set up the CRO monitor to display the tape recorder input. Start the video tape recorder and record a SHORT interval of the horizontal multiburst (pattern 20), a SHORT interval of $\sqrt{2}$ grey scale (pattern 01), and a SHORT interval of white level (pattern 50). During the recording interval, monitor and record the amplitudes of all components of each test pattern on the CRO for playback comparison.

RBV FM Downlink Test (cont)

Seq	Test	Operator	Instructions
12	Re-cord/ Repro-duce	RBV/TR-70	Set up the recorder for reproduce (playback) mode into the VPASS. Set up the CRO Monitor to monitor the raw playback data into the VPASS. Set up the VPASS for playback operation. Start the VTR and play back the recorded data. Monitor and record the relative amplitudes of all components of each test pattern as measured on the oscilloscope. Verify correct operation and sequencing of all VPASS front panel indicators throughout tape playback.
13	Re-cord/ Repro-duce	RBV/TR-70	Compare the amplitudes of oscilloscope displays as measured in sequences 11 and 12 and verify that the data meets the test criteria of item 6, table 2-6.
14		USB/MFR/ RBV/TR-70	Configure all equipment for mission support, remove scratch tape from recorder, and install mission support tape. END TEST

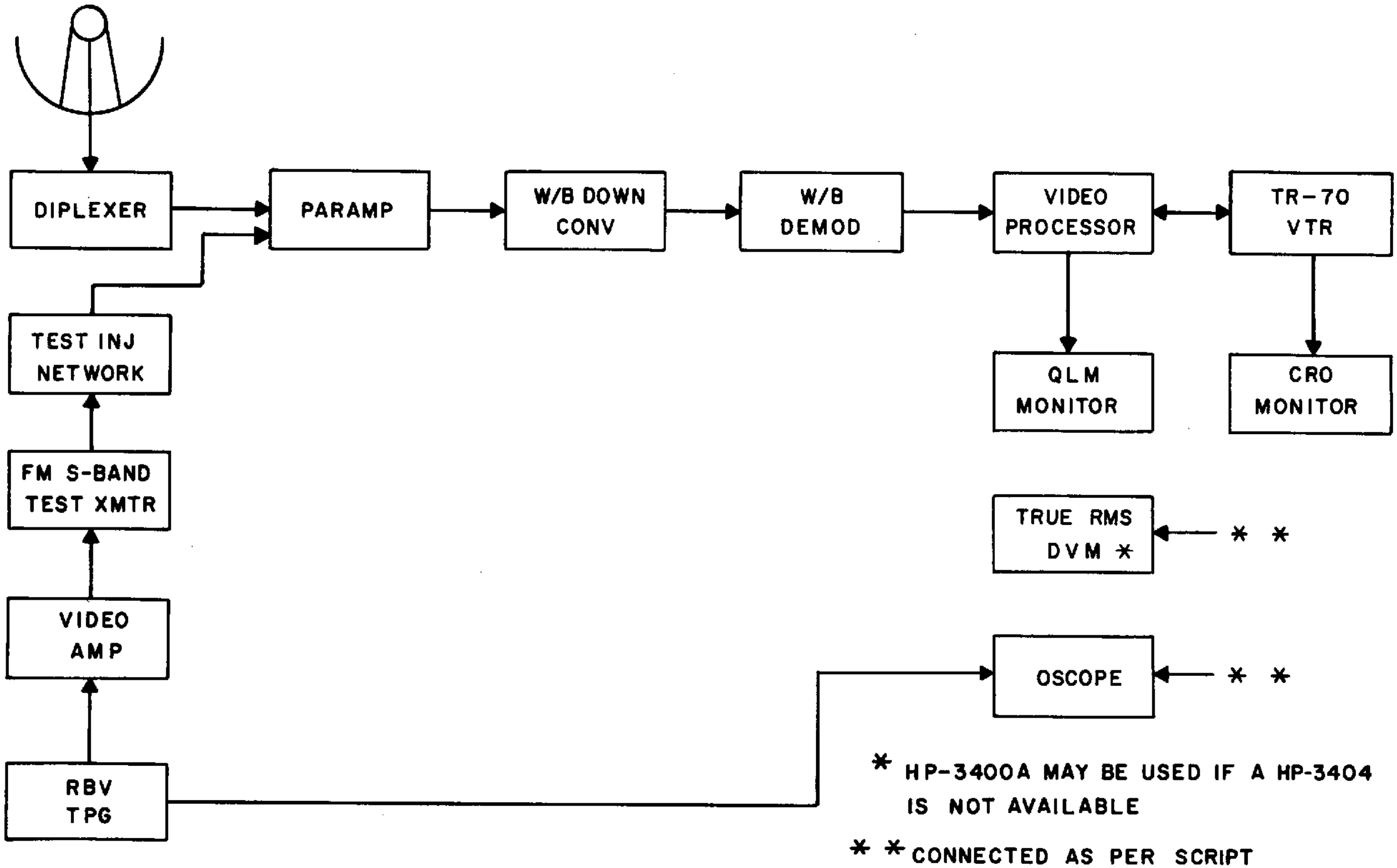
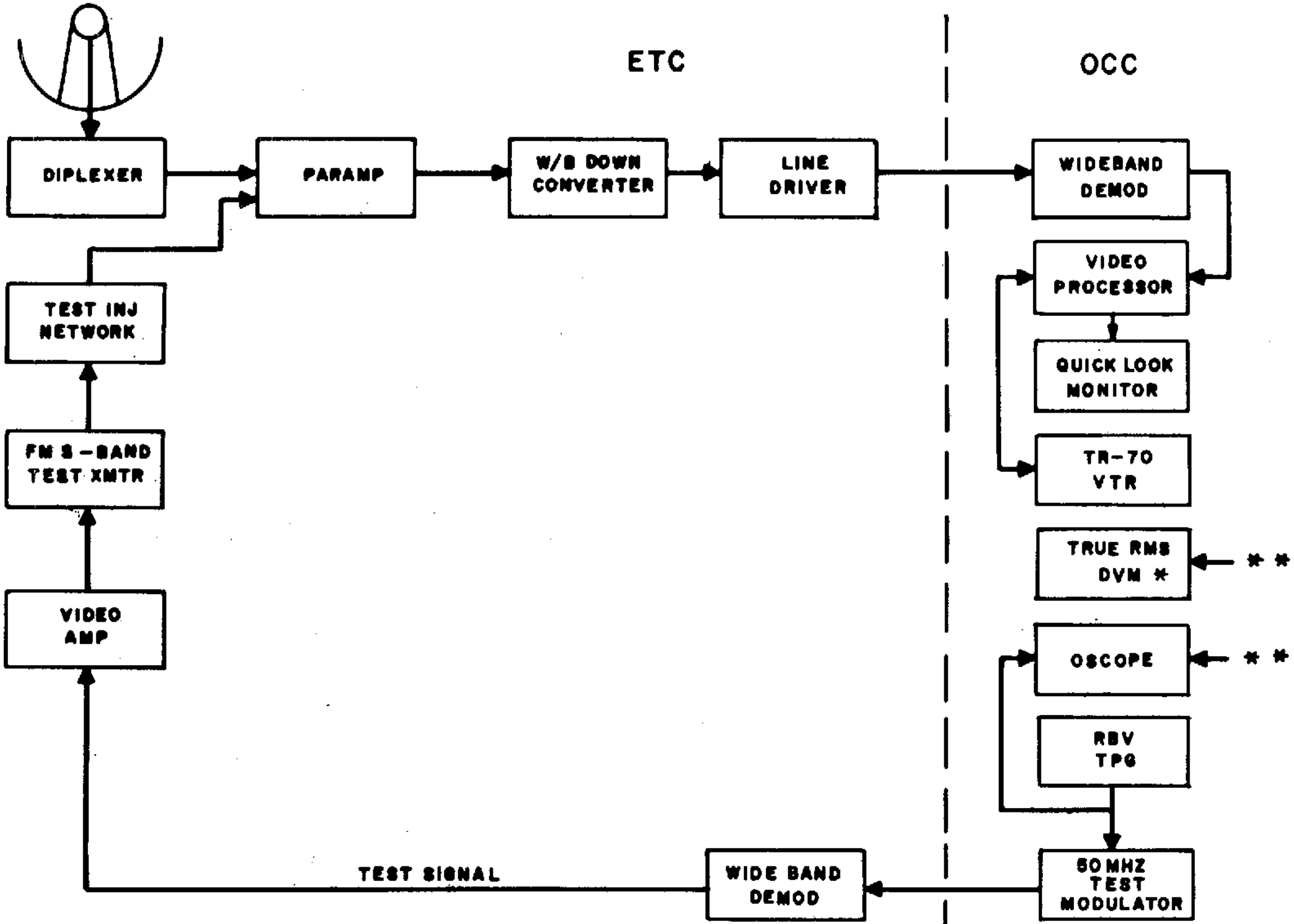


Figure 2-23. RBV Downlink Test Configuration (GDS)



** CONNECTED AS PER SCRIPT

* HP-3400 A MAY BE USED IF HP-3403 IS NOT AVAILABLE

Figure 2-24. MSS/RBV Test Configuration ETC/OCC

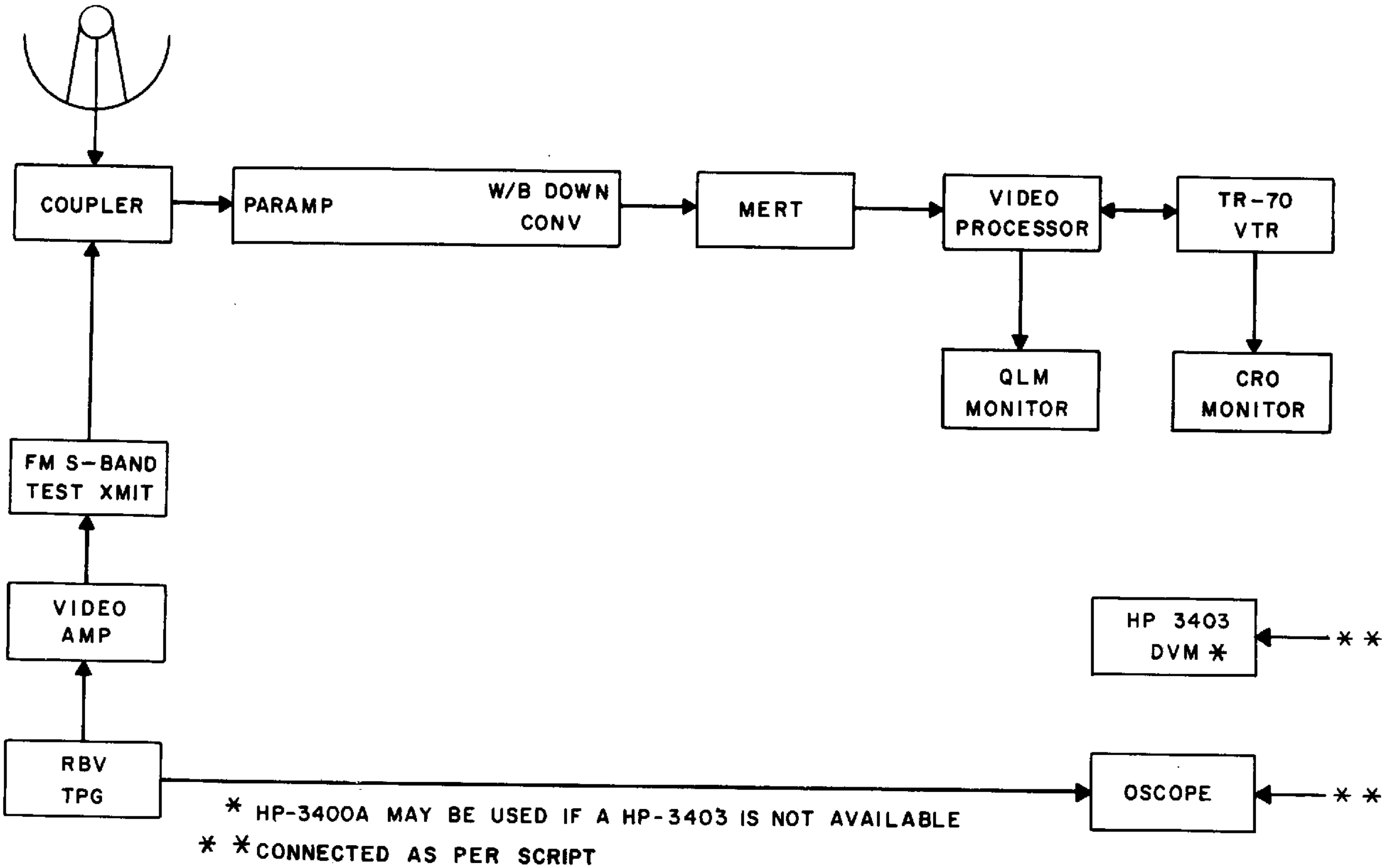


Figure 2-25. RBV Downlink Test Configuration (ULA)

Table 2-5. Equipment Test Parameters

Equipment	Control/Function	Indication/Setting
Test transmitter	FREQUENCY	2229.5 MHz
	DEVIATION	±5.6 MHz
USB wideband downconverter	FREQUENCY	2229.5 MHz
	IF BANDWIDTH	30.0 MHz
USB wideband demod *	IF BANDWIDTH	20.0 MHz
	MODE	LOCAL
Multifunction receiver (Alaska only)	BAND SELECT	2200 - 2300 MHz
	CHANNEL SELECT	429.5 MHz
	IF BANDWIDTH	20.0 MHz
	VIDEO BANDWIDTH	5.0 MHz
	DEMOD SELECT	FM
	TUNING MODE	OPEN LOOP
	TRACKING BANDWIDTH	300 Hz
	AGC SPEED	30 ms
VPASS*	INPUT SELECT	FM RECEIVER
	DISPLAY ENABLE/DISABLE	ENABLE
	DISPLAYED FRAME SEL	ENABLE 1, 2 & 3
	VERT SYNC MODE SEL	NORMAL
	ACQUISITION CYCLE	EACH FRAME
	Δ 0T ENABLE/DISABLE	ENABLE
	Δ1 ENABLE/DISABLE	ENABLE
	Δ3 ENABLE/DISABLE	ENABLE
	RE-ACQUISITION MODE	ENABLE
	HORIZ SYNC OUTPUT	PLL
	EARLY TRANSPORT RUN	AUTO

*For NTE testing this equipment is located at the OCC.

Table 2-5. Equipment Test Parameters (cont)

Equipment	Control/Function	Indication/Setting
TPG	MODE SELECTION	NORMAL*
	CYCLE	CONTINUOUS
	CAMERA No. 1	ON
	CAMERA No. 2	ON
	CAMERA No. 3	ON
	INT-EXT CLOCK	INT
	FILTER IN/OUT	IN
	PATTERN SELECT	As required
Link noise gens	POWER	OFF

*Continuous read may be utilized when more convenient.

Table 2-6. Test Criteria

Item	Parameter	Station		
		ULA	GDS	ETC/ OCC
1	(RBV patch panel J-23)	1.0 Vpp	1.0 Vpp	1.0 Vpp
	White reference Level	+1.0 V	+1.0 V	+1.0 V
	Black reference Level	+0.27 V	+0.27 V	+0.27V
	SYNC tip Level	0.0 V	0.0 V	0.0V
2	VPASS Output S:N (Video out RBV patch panel J-23)	39±2 dB	41±2 dB	41 ±2dB
3	VPASS frequency response (Video out RBV patch panel J-23)	Flat within 3 dB	Flat within 3 dB	Flat within 3 dB
4	White level tilt	5 MV/ line	5 MV/ line	5 MV/ line
5	VPASS Linearity	±3 %	±3 %	±3 %
6	TR-70 VTR, frequency response	±1.5 dB	±1.5 dB	±1.5 dB
	White level tilt	5 mV/ line	5 mV/ line	5 mV/ line
	Linearity	±3 %	±3 %	±3 %

2.9 LAUNCH VEHICLE TESTS

There are two launch vehicle tests:

a. Launch Vehicle, Second Stage Data Flow Test (MAD, HAW and ULA).

b. Tananarive Launch Vehicle Support.

2.9.1 LAUNCH VEHICLE, SECOND STAGE DATA FLOW TEST (MAD, HAW AND ULA)

OBJECTIVE

The objective of this test is to make an end-to-end check verifying that the supporting stations are patched according to mission requirements and are processing data correctly.

TEST DESCRIPTION

The objective is accomplished by first making a signal plus noise-to-noise check at the video output of the Motorola FM demod for MAD, or the MFR video output for ULA or the video outputs of the 2074-1 VHF receiver and combiner for HAW. Then, the second stage IRIG multiplex is simulated using the Vidar 8812 Frequency Calibrator for the continuous channels. Two Programmable Voltage Controlled Oscillators (PVCO's) model 6009 are utilized. One PVCO is set for IRIG E and modulated with the Launch Vehicle PDM pulsetrain generated from the SS-13 simulator. The other PVCO is set for IRIG G and modulated with a PCM pulsetrain from a PCM simulator or square-wave generator.

The two PVCO's and the Vidar mixer output are summed through the summing amplifier of the PSK Signal Simulator model 829.

The multiplex from the PSK Signal Simulator FM modulates a test transmitter tuned at 2241.5 MHz. The modulated carrier is injected in to the parametric amplifier at a certain input level. The multiplex is recovered at the Motorola FM demod video output for MAD, or the MFR video output for ULA or at the combiner for HAW, and routed to the discriminator bank.

The PDM pulsetrain is recovered at the IRIG E discriminator output. Stations required to decommutate and FM remote selected PDM channels will route the pulsetrain to a PDM decommutator. The selected PDM channels, via DAC-13, will be remoted through the EMR-4900 FM multiplexer. Stations required to voice report mark events in real time will route the DAC-13 directly to the stripchart recorder.

Stations required to FM remote continuous channels will route the output of these discriminators to the EMR-4900 FM multiplexer. Stations required to voice report in real-time events from these channels will route the output of the applicable discriminators directly to the stripchart recorder.

The output of the FM remoting EMR-4900 will be discriminated, every channel will be displayed on a stripchart recorder and each trace will be evaluated.

After discrimination, the PCM pulsetrain will be displayed on an oscilloscope and compared with the original PCM trace.

Note

1. The tests in this section are applicable to MAD, HAW and ULA. Peculiarities of ULA have been identified throughout the test.

2. If possible, stations required to FM remote selected parameters do not remove the discriminator/stripchart set-up at the output of the FM remoting EMR-4900, retain this configuration for monitoring the VCO's at all times.

3. During this test all signals will be recorded as specified in the NOSP (STDN No. 601/ERTS) and section 2.2 of this document.

TEST EQUIPMENT REQUIRED

The following test equipment or equivalent is required for the performance of this test:

Signal Generator, Hewlett-Packard 8614A
Signal Generator, Hewlett-Packard 651
Spectrum Analyzer, Hewlett-Packard 851/8551A
Frequency Calibrator, Vidar 8812
VTVM, Hewlett-Packard 3400A

2.9.1.1 Set-up Instructions

Note

See figure 12-1, Second Stage Telemetry Data Flow, Typical Equipment Configuration (MADRID, HAWAII and ALASKA).

2.9.1.2 USB/S-band (ULA)

a. Determine the modulation sensitivity of the FM test transmitter (see appendix A).

b. Using the modulation sensitivity determined above, calculate the required voltage for each IRIG VCO 1, 6 through 13, A, C, E and G to produce the corresponding deviations on the carrier as listed in table 2-7. Also, calculate the required voltage to produce a peak deviation of 250 KHz.

c. Furnish the calculated voltages in table 2-7 to the RF TLM.

d. MAD, verify the USB receiver, Motorola demodulator and TV filter amplifier are set as specified in the NOSP (STDN No. 601/ERTS).

e. ULA, verify that the S-band system is set up as specified in the NOSP (STDN No. 601/ERTS).

f. Set the HP-651 Signal Generator to 104 KHz and set the rms voltage output to the value calculated in step b.

Table 2-7. Carrier Deviations

IRIG VCO	Required Deviation Peak (KHz)	Required VRMS
1	9.3	
6 through 13	9.3	
A	9.3	
C	19.0	
E	44.0	
G	93.0	

2.9.1.3 PCM-TLM

a. MAD and HAW

(1) Set simulator controls as follows:

	Control	Setting
OUTPUT DATA CONTROL:		
	CODE TYPE	NRZ-C
	POLARITY	POS
	COUPLING	DC
	OUTPUT FUNCTION	SIGNAL
	OUTPUT SOURCE	STORED PROGRAM
SYSTEM FUNCTION:		
	FORMAT	LOCAL
	BIT RATE	VARIABLE
	BITS PER SEC.	1.389
	MULTIPLIER	1K

(2) Manually read in the following program in to the simulator.

ADDRESS (OCTAL)	INSTRUCTION
0007	111011111110000 0000
3760	000011111110010 0000
3761	111111111110010 0001
3762	000010011101010 1010

(3) Select format number 8. Verify a 1-0 output pattern and adjust OUTPUT AMPLITUDE P-P for ±5 volts.

b. ULA

Patch the MSFTP-1 simulator to output an alternate 1-0 pattern, NRZ-C code type at 13.89 Kb/sec and adjust the output amplitude for ±5 volts.

Note

A square-wave generator may be used; set up for 7.0 kHz and ±5 volts output in lieu of the MSFTP-1 simulator.

2.9.1.4 RF-TLM

a. HAW, set the 2074-1 receiver and combiner as specified in the NOSP.

b. Set up and calibrate the IRIG discriminators required for mission support as specified in STDN No. 502.2/NOSP ERTS.

c. Set up and calibrate the FM remoting VCO's of the EMR-4900 multiplexer as specified in the 502.2/NOSP ERTS.

d. Calibrate the IRIG discriminator used to discriminate the FM remoted multiplex, for 0V, +5 V and +10 volts for L.B, C.F. and U.B. respectively.

e. Set one PVCO model 6009 for IRIG E center frequency (40.0 kHz) and ±15 percent deviation (±6.0 kHz). Set for NORMAL mode of operation and the INPUT RANGE switch for ±5 V.

f. Set a second PVCO model 6009 for IRIG G center frequency (124.0 kHz) and ±15 percent deviation (±18.600 kHz). Set for NORMAL mode of operation and the INPUT RANGE switch for ±5 V.

g. PDM (STELLARMETRICS) SYSTEM

(1) Set the SS-13 controls as follows:

Control	Setting
(a) RATE MODULATION OFF-EXT-INT	OFF
(b) RATE PPS	*
(c) MAIN FRAME LENGTH	*
(d) SUBFRAME LENGTH	999
(e) SUBFRAME LOCATION	999
(f) MODE	PDM
(g) FRAME SYNC FORMAT:	
1. MF IRIG	*
2. MAIN FRAME PATTERN	OFF OFF OFF OFF
3. SUBFRAME PATTERN	N/A
4. SF IRIG	N/A
(h) CHANNEL ASSIGNMENTS:	
1. ZERO REF	*
2. FS REF	*

3. SPECIAL 0000

4. GROUP $\frac{20\%}{1}$ $\frac{40\%}{2}$ $\frac{50\%}{3}$ $\frac{60\%}{4}$ $\frac{80\%}{5}$ $\frac{20\%}{6}$ $\frac{40\%}{7}$ $\frac{50\%}{8}$ $\frac{60\%}{9}$ $\frac{80\%}{10}$

(i) MISSING CHAN	*
(j) NOISE	OFF
(k) FILTER	OFF
(l) OUTPUT POLARITY	+

(2) On the SS-13, perform the following adjustments (connect oscilloscope).

(a) Using the PDM-ZERO control adjust the pulse width of the zero reference channel to 130 microseconds.

(b) Using the PDM-F.S. control, adjust the pulse width of the full scale reference channel to 700 microseconds.

(c) Using the OUTPUT GAIN and OUTPUT LEVEL controls, adjust the pulse-train amplitude for 0 to +10 volts.

(3) Set the KRON-HITE 3200R-Z filter controls as specified in STDN No. 601/ERTS.

(4) Set the DDF-13 controls as specified in the STDN No. 601/ERTS with the following exceptions:

Control	Setting
SERVO:	
LEVEL	OFF
GAIN	OFF
CALIBRATE	100

Note

These controls are reset as specified in the NOSP (STDN No. 601/ERTS) at the proper time after the necessary set-up instructions have been completed.

(5) Patch the SS-13 output in to the DDF-13 and perform the following adjustments:

(a) Set METER SELECT switch at RATE and CHANNEL RATE selector switch at the .5-2.5K position. Monitor the internal clock frequency on the front panel meter and adjust the VAR control for 900 pps meter indication.

(b) Set CALIBRATE selector switch to INFO position.

*Denotes control settings to be set as specified in the NOSP (ERTS).

(c) Observe the amplified data signal at AMPL INPUT test point TP-1. Adjust the zero percent and 100 percent data levels with the LEVEL and GAIN controls to 0 V and +10 V.

(d) Set METER SELECT switch at DEV and adjust the VAR control for center meter indication.

(e) Verify channel frame synchronization as indicated on the front panel SYNC STATUS indicators.

(f) Set the DISPLAY SELECT switch at ZERO REF position and adjust the LEVEL control so that the DISPLAY lamps indicate:

0000000110 (unless otherwise specified by the 601/ERTS)

(g) Set the DISPLAY SELECT switch at FS REF position and adjust the LEVEL control so that the DISPLAY lamps indicate:

1111111001 (unless otherwise specified by the 601/ERTS)

Note

Repeat steps (f) and (g) because there may be some control interaction.

(h) If required by the mission supplements, energize both LEVEL and GAIN servos by depressing the respective PBI's and adjust or verify that LEVEL and GAIN servos have been adjusted to the same guardband as in steps (f) and (g).

(6) On each DAC-13 perform the following:

(a) Set M.F.-S.F. switches at M.F. for all ten channels.

(b) Set C.T. switches at 0 for all ten channels.

(c) Set thumbwheel switches for each of the ten channels to the F.S. REF. channel.

(d) Connect a digital voltmeter sequentially to channels 1 through 10 (OUTPUT connectors J710A through J719A) and adjust the corresponding G potentiometers for 9.940 volts ±10 mV.

(e) Set thumbwheel switches for each of the ten channels to the ZERO REF channel.

(f) Connect a digital voltmeter sequentially to channels 1 through 10 (OUTPUT connectors J710A through J719A) and adjust the corresponding L potentiometers for 60 mV ±10 mV.

(g) Set the CHANNEL and C.T. thumbwheel switches as specified in NOSP (STDN No. 601/ERTS).

(h) Set the pre-emphasis as follows:

1. Request USB (S-band for ULA) to furnish the calculated RMS voltages (refer to para 2.9.1.2b).

2. Set the PSK simulator summing amplifier to unity (do not readjust the gain).

3. Patch the PVCO (IRIG G) to one of the external summing amplifier inputs of the PSK simulator. Set the PVCO gain for an rms meter indication at the output of the PSK simulator equal to the rms level furnished in step 1 . Unpatch this PVCO.

4. Patch the PVCO (IRIG E) to the second external summing amplifier input of the PSK simulator. Set the PVCO gain for an rms meter indication at the output of the PSK simulator equal to the rms level furnished in step (1). Unpatch this PVCO.

5. Patch the Vidar 8812 frequency calibrator to the third external input of the PSK simulator and perform the following:

a. Select one mixer and set its gain to unity. Set for C. B. frequency.

b. Switch one VCO on at a time (1, 6 through 13, A and C) to the selected mixer and adjust the corresponding gain potentiometer on each VCO for an output level, at the output of the PSK simulator, equal to the level furnished in step 1 .

c. After each VCO level is set switch all VCO's (1, 6 through 13, A and C) in to the selected mixer.

d. Set DWEL (sec) switch to position 5, ONE CYCLE/CONTINUOUS switch to CONTINUOUS, and press the START PBI.

e. Path the two PVCO's (IRIG E and IRIG G).

2.9.1.5 RF-Telemetry Patching

a. Patch the PCM simulator or square-wave generator output to the PVCO (IRIG G).

b. Unpatch the SS-13 simulator from the DDF-13. Readjust the simulator output for ±5 volts and patch it to the PVCO (IRIG-E).

c. Patch the recovered IRIG multiplex from the SDDS (MAD) or combiner (HAW), or the MFR FM demodulator (ULA) to the bank of discriminators.

d. If your station is required to FM remote selected segments from the PDM pulsetrain, patch the output of the IRIG discriminator E to the DDF-13 assigned for mission support, and patch the selected DAC-13 channels to the VCO's of the EMR-4900 FM multiplexer (for specific channel assignments, see the NOSP/ERTS). Also, patch the selected PDM segments from the DAC-13 directly to the stripchart recorder. Patch the output of the FM remoting EMR-4900 FM multiplexer to the discriminators calibrated in para 2.9.1.4d. Stations required to only voice-report mark events from selected segments of the PDM pulsetrain, patch the assigned DAC-13 output channels directly to the stripchart recorder.

e. If the station is required to FM-remote the PDM pulsetrain, patch the output of the IRIG E discriminator directly to the VCO of the FM remoting EMR-4900. The station may patch the output of the discriminator E to the DDF-13 for monitoring purposes. In addition, patch the output of the FM remoting EMR-4900 to a compaible discriminator and patch the output of the discriminator to the stripchart recorder or visicorder. Also, patch the output of the SS-13 simulator to the stripchart recorder or visicorder.

f. If station is required to FM-remote continuous channels, patch the output of the appropriate discriminators to the VCO's of the FM-remoting EMR-4900 (for specific channel assignments, see the NOSP/ERTS). In addition, patch the output of the FM-remoting EMR-4900 to compatible discriminators and the output of these discriminators to the stripchart recorder.

If the station is required to only report the occurrence of mark events from these continuous channels, patch the output of the applicable discriminators directly to the stripchart recorder.

In either case, also patch the output of the vidar 8812 frequency calibrator to any available discriminator (1, 6 through 13, A or C) and the output of the discriminator to the stripchart recorder (see figure 2-25A).

g. If the station is required to FM-remote timing, patch the required time code to the assigned VCO of the EMR-4900 and to the stripchart recorder or visicorder. In addition, patch the output of the EMR-4900 to a compatible discriminator and the output of this discriminator to the stripchart recorder or visicorder (for specific assignments, refer to the NOSP).

h. Patch the IRIG G discriminator output to a PCM line.

2.9.1.6 Test Procedure

Seq	Operator	Instructions
1	TC	Verify the following: (1) USB (S-band for ULA) on loop (2) RF-TLM on loop (3) PCM TLM on loop (4) Recorder on loop (5) Set up instructions have been completed.
2	USB/S-band	a. Patch the HP-651 signal generator to the FM test transmitter. b. Set the input level in to the USB parametric amplifier to -94 dBm for cooled parametric amplifier or -91 dBm uncooled micro-mega parametric amplifier. ULA set input level in to the preamplifier to -94 dBm
3	USB/S-band/ RF-TLM	a. HAW, using the VTVM take a reading at each video output of the 2074-1 VHF receiver and combiner with modulation on and a reading with modulation off. The difference between the two readings should be 27 dB or better. (500 kHz IF, 300 kHz video FLT) b. MAD, using the VTVM take a reading at the USB Motorola demodulator video output with modulation on and a reading with modulation off. The difference between the two readings should be 20 dB or better.(5.0 MHz IF, 500 kHz VIDEO FLT) c. ULA, using the VTVM take a reading at the MFR FM demodulator video output with modulation on and a reading with modulation off. The difference between the two readings should be 23 dB or better.(600 kHz IF, 300 kHz VIDEO FLT)

Seq	Operator	Instructions
4	USB	a. Unpatch the HP-651 signal generator from the FM test transmitter and patch the PSK simulator output. b. Verify that the input level in to the parametric amplifier is same as in sequence 2.
5	RF-TLM	Verify synchronization on the DDF-13 and run stripchart recorder or visicorder for approximately 60 to 90 seconds.
6	TC/RF-TLM/ PCM-TLM	Evaluate the test results as follows: a. Verify that the traces of the continuous channels are stepping from zero percent to 100 percent in 25 percent increments and compare their trace with the trace of the original step function displayed from the vidar via the discriminator. b. Verify that the traces of the selected PDM segments are dc lines and are of correct levels. c. Compare the trace of the PDM pulsetrain displayed from the output of the FM remoting multiplexer with the original PDM signal displayed directly from the output of the SS-13. Verify that the pulse duration of the data channels is stepping sequentially 20%, 40%, 50%, 60% and 80%. d. Compare the timing trace of the output of the FM remoting multiplexer with the trace displayed from the timing source. e. On the oscilloscope, verify the presence of the recovered PCM pulsetrain and compare with the PCM pulsetrain displayed directly from the PCM simulator. f. Announce end of test.

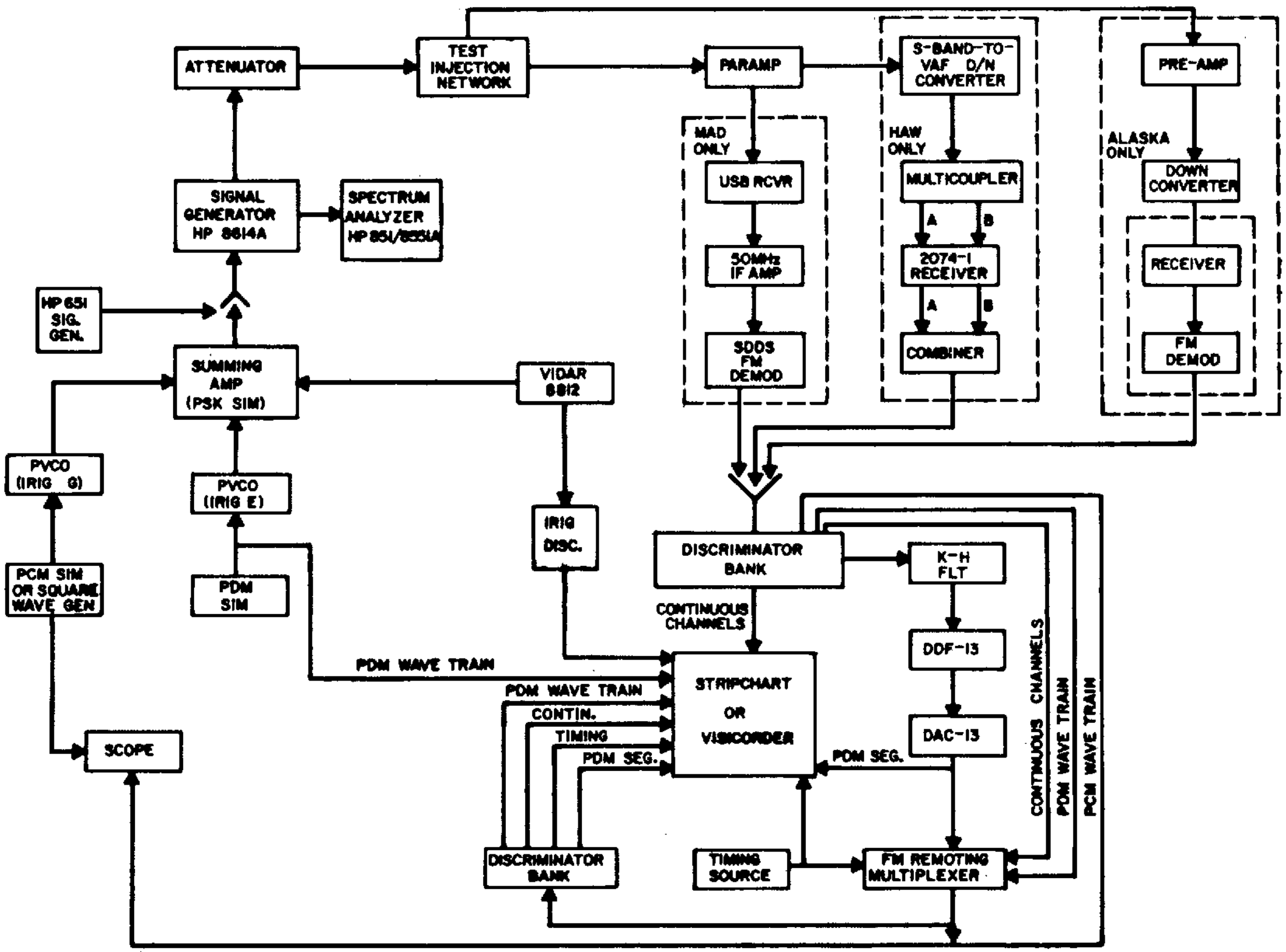


Figure 2-25A. Second Stage Telemetry Data Flow, Typical Equipment Configuration (MAD, HAW and ALASKA)

2.9.2 TANANARIVE LAUNCH VEHICLE SUPPORT

2.9.2.1 General. The tests described in this section are applicable only to the Tananarive Station. This section contains five test series used to verify the station's capability for Launch Vehicle Support. These tests cover the following:

a. Video transmission lines.

b. Telemetry Building - SCO.

c. Discriminators.

d. Stripcharts recorders.

e. FMT-500 subcarrier oscillators.

f. System threshold.

All testing will be performed with the equipment set up as defined by the ERTS NOSP and operated in accordance with existing operational directives.

All backup equipment is to be tested and proved to the same extent as prime equipment. Particular care is to be exercised in evaluating the performance of the RF, magnetic recording, and real-time components and subsystems.

When the sub-standard operation of a component or subsystem is detected, the fault will be determined and corrected.

2.9.2.2 Video Transmission Lines

a. General. The following tests verify the frequency response and noise level of the video transmission lines between the Telemetry and GRARR buildings.

b. Procedure

(1) Connect the output of a low frequency oscillator (HP 202C) to the input of an LDA 500 line driver. Shunt the input of the line driver with a 90-ohm resistor. Also, bridge the output of the 202C with a true RMS voltmeter (HP 3400A).

(2) Patch the output of the LDA to the input of one of the coax transmission lines between the telemetry and GRARR buildings.

(3) Terminate the GRARR end of the line with an HP 3400A voltmeter shunted with a 90-ohm resistor.

(4) Adjust the output of the 202C for 1 kHz at a level of 2.5 Vrms.

(5) Adjust the output of the LDA 500 for an output level of 2.5 Vrms.

(6) Note the level of the GRARR termination for reference.

(7) Maintain the output at the 202C constant and measure the output of the line at the GRARR (express in dB) at each of the following frequencies:

(a) 200 Hz.

(b) 500 Hz.

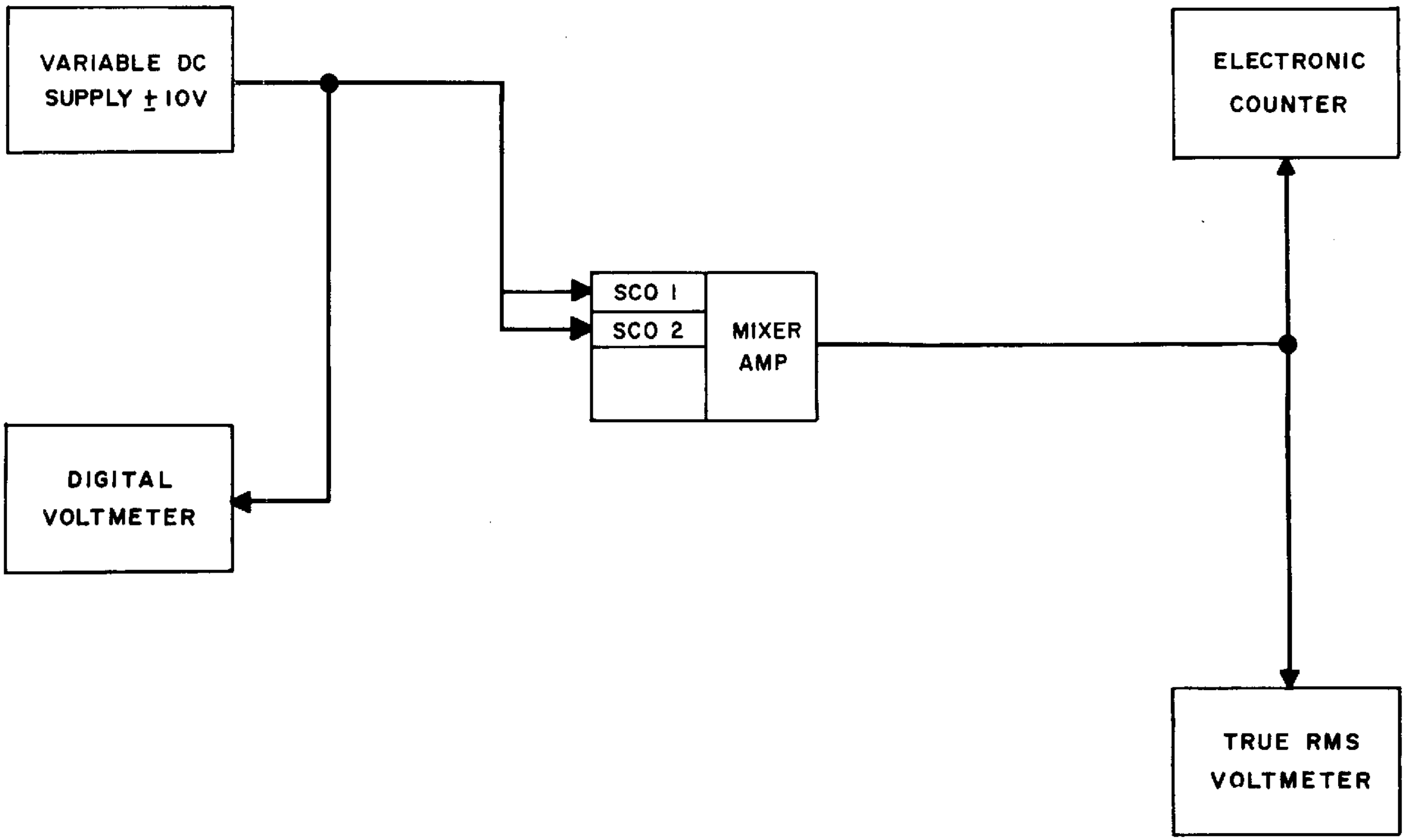


Figure 2-26. SCO Calibration Test

(c) 1 kHz.

(d) 2 kHz.

(e) 5 kHz.

(f) 10 kHz.

(g) 20 kHz.

(h) 40 kHz.

(i) 80 kHz.

(8) Remove the signal generator and short the input to the line driver. Read the rms noise level at the GRARR termination. It is anticipated that the noise level will be -30 dB from reference.

(9) Remove the short from the input to the line driver.

(10) Repeat steps (2) through (9) for each of the required remaining coax lines.

2.9.2.3 Telemetry Building - SCO

a. General. This test is intended to confirm the readiness of the Sonex VCO at the telemetry building to transmit the channel A and B AGC voltages from the DTR receiver to the GRARR building.

b. Procedure

(1) Set up the Sonex Subcarrier Oscillators (SCO) as shown in figure 2-26.

(2) Turn off all SCO's, except IRIG Channel 1.

(3) Adjust the output level of the SCO and the mixer-amplifier for 1 Vrms as indicated on the voltmeter contained in the SCO assembly.

(4) Adjust the output of the dc supply for zero volts as indicated on the digital voltmeter (DVM) (HP 2401C or equivalent).

(5) Adjust the center frequency of the SCO for 400 Hz; refer to table 2-8.

(6) Set the output of the dc supply to plus 2.0 volts as indicated on the DVM.

(7) Adjust the deviation for plus 4.5 percent; table 2-8.

(8) Set the output of the dc supply to minus 2.0 volts and compare the output frequency to -4.5 percent in table 2-8.

(9) Turn off channel one and turn on channel three (730 Hz).

(10) Repeat steps (3) through (8) for IRIG channel 3; refer to table 2-8 for frequencies.

(11) Connect the AGC outputs of receiver 1 (Channel A) and receiver 2 (Channel B) through the Neotec AGC record module to the inputs of SCO 1 (400 Hz) and 3 (730 Hz), respectively. Refer to figure 2-27.

(12) Connect the CW output of an 8614 signal generator set to 2241.5 MHz and an output equivalent to -80 dBm at the preamplifier inputs to the test signal input.

(13) Set up the diversity receiver to receive the 2241.5 signal.

(14) Note the frequency output of the number 3 channel on the counter. It should be at +4.5 percent (763 Hz).

(15) Adjust the output of the 8614 for 60 dB below the level set in step (12). This is equal to -140 dBm.

(16) Note the frequency output of the number 3 channel SCO, -4.5 percent (697 Hz).

(17) Turn off channel 3 and turn on channel 1.

(18) Repeat paragraphs (12) and (14) through (16). The frequencies for channel 1 are contained in table 2-8.

(19) Patch the mixer amplifier through one of the coax transmission lines to the GRARR building. Terminate the line to the input at the pair of discriminators to be used to separate the AGC data. Shunt the input of the discriminator composite input with a 90-ohm resistor.

(20) Turn on channel 3 SCO's and adjust the mixer amplifier for an output of 2.5 Vrms.

Table 2-8. Channels 1 and 3 Deviation

	Channel 1	Channel 3
fc	400 Hz	730 Hz
-4.5 percent	382 Hz	697 Hz
+4.5 percent	418 Hz	763 Hz
Tolerance ±1 Hz		

2.9.2.4 Discriminators

a. General. The purpose of this test is to confirm the proper operation and patching facilities of the Sonex S-45 discriminators used for the real-time frequency demultiplexing.

b. Procedure

(1) Set up and calibrate the Sonex S-45 discriminators in accordance with the mission requirements as specified in STDN No. 601/ERTS.

(2) Use the calibrator and a DVM to verify the output linearity of each discriminator at five points with peaks of $\pm$ 7.5 % deviation.

(3) Determine the output linearity of each discriminator. Specifications are 0.1 % of bandwidth.

$$\text{Linear percent} = \frac{100\ (BW/2) + (E_C - E_L)}{BW}$$

Where: E_C = Output voltage at fc
E_L = Peak positive voltage at bandedge.
BW = Peak-to-peak voltage for bandwidth.

2.9.2.5 Stripchart Recorders

a. General. The following test will confirm the proper operation of the discriminator and Sanborn recorders. Two stripchart recorders are required for the test setup.

b. Procedure

(1) Patch the outputs of the discriminators 1 through 5, Group A, to pens 1 through 5 of recorder one. Refer to figure 2-27 and applicable section of the ERTS/NOSP.

(2) Patch the timing to the event marker.

(3) Patch the outputs of discriminators 1 through 8, Group B, to pens 1 through 8 of recorder 2, timing on the event marker.

(4) Operate the recorder at 10 mm/sec and calibrate the pens for full scale deflection with 7.5 percent deviation.

(5) Record approximately one minute of the 5-point calibration.

(6) Stop the recorder and evaluate the chart for linearity.

2.9.2.6 FMT-500 Subcarrier Oscillators

a. General. The intent of this test is to confirm the operational readiness of the SCO's and their capability to accept the data inputs anticipated during the mission support.

b. Procedure. Using a variable dc supply and a DVM, verify that all the required SCO channels for Mixer 1, 2, and 3 outputs can be properly deviated for their respective input ranges.

2.9.2.7 System Threshold

a. General. This test will define the minimum signal level at which the discriminators will operate using the telemetry and GRARR systems. For the test configuration, refer to figure 2-27.

b. Set-up Instructions

(1) See figure 2-27, Second Stage Telemetry Data Flow Equipment Configuration.

(2) Determine the modulation sensitivity of the FM test transmitter (see appendix A) for both the R&RR and Telemetry System.

(3) Using each of the modulation sensitivities determined above, calculate the required voltage for each IRIG VCO 1, 6 through 13, A, C, E, and G to produce the corresponding deviations on the carrier as listed in the table 2-9.

Table 2-9. Carrier Deviations

IRIG VCO	Required Deviation Peak (kHz)	Required VRMS	
		12 Meter	4 Meter
1	9.3		
6 through 13	9.3		
A	9.3		
C	19.0		
E	44.0		
G	93.0		

(4) Verify that the station is properly configured for vehicle TLM support according to the specifications in the NOSP (STDN No. 601/ERTS) and according to applicable operational directives.

(5) Modulate the RF signal generators with the composite IRIG modulation.

(6) Setup the PDM (Stellametrics) system in accordance with section 2.9.1.4g of this SRT.

(7) Start the stripchart recorders. Using the discriminator calibrator, record at least two cycles of 5 points of calibration, then stop the recorders.

(8) Temporarily disconnect the video input to the TLM RF signal generator and with the chart and magnetic recorders operating, vary the CW input to the telemetry building system from -80 to -140 dBm in 5 dB steps to calibrate the AGC. Stop all recorders.

(9) Reconnect the video input to the RF signal generator; repatch the discriminator to the DTR video output (figure 2-27).

(10) Set the RF signal generator for -80 dBm output.

(11) Reset the tape index counter of each tape recorder.

(12) Start the magnetic and stripchart recorders.

(13) Decrease the signal strength in 3-dB increments and dwell at each new level for approximately 30 seconds. Continue decreasing the signal level until all discriminators lose lock, plus two more increments of 3 dB each. Voice annotate the steps.

(14) Stop all recorders. Label the stripchart records as follows:

Date

Stripchart number

Pen assignments

Real-time simulated threshold, pass 1

(15) Mark the tape index counter of the magnetic recorders. Label each tape:

Date

Recorder

Track assignments

Real-time simulated threshold, pass 1

Tape index count at LOS

(16) Repeat paragraphs (7) through (15) using the GRARR system. Label all records as indicated in paragraphs (14) and (15), except to note that the data are pass 2.

(17) Rewind the magnetic recorders to the beginning of the Pass No. 1 recording.

(18) Reconfigure the system to allow for playback of the DTR video into the vehicle telemetry baseband equipment.

(19) Start the magnetic tape recorder.

(20) Examine the quality of the video data using the vehicle telemetry baseband equipment.

(21) Examine all other data tracks on the tape recorder using the tape evaluation unit.

(22) Compare the LOS signal level of real time to playback.

(23) Repeat steps (18) through (22) for the GRARR systems and for tape recorder No. 2.

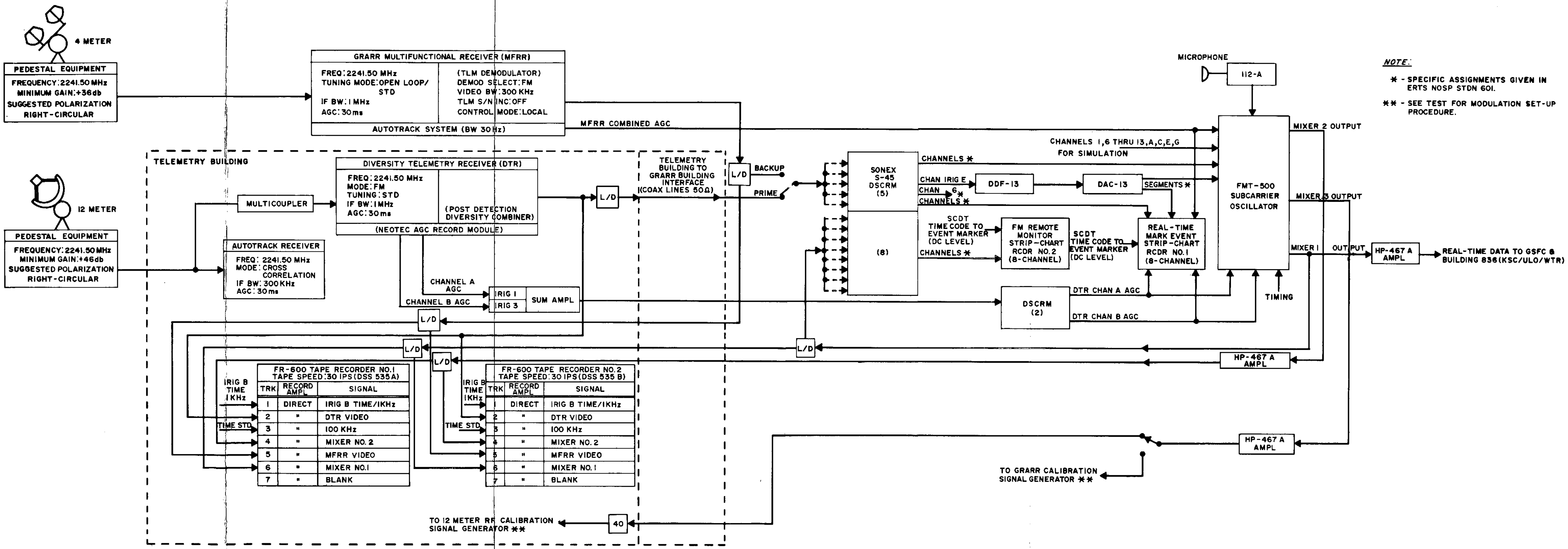


Figure 2-27. Second Stage Telemetry Data Flow Typical Equipment Configuration (TAN)

FOLDOUT FRAME 1

FOLDOUT FRAME 2

FOLDOUT FRAME 3

2.10 REMOTE SITE DATA PROCESSOR AND PERIPHERAL EQUIPMENT

OBJECTIVE

The objective of these tests is to verify that the Remote Site Data Processors (RSDP's) and mission-associated equipment is capable of supporting mission requirements.

GENERAL

The COUNTDOWN short diagnostic program will be performed to first qualify the internal operation of the computers. An error-free 1232 Input/Output (I/O) console printout of COUNTDOWN test results is located in SCAN No. 6-049.

There are three versions of the COST program. Selected portions of the applicable program will be used to test the High-speed Printer (HSP), Magnetic Tape Units (MTU's), Command Analog Generation Equipment (CAGE), Updata Buffer (UPB), Pulse Code Modulators (PCM's), Time Code Translator (TCT), Command Status Test (CST), Teletypewriters (TTY's), Data Transmission Units (DTU's), Interface Systems Adapter (ISA), and Greenwich Mean Time (GMT). All testing performed according to procedures given in paragraph 2.10 will use equipment designated to support the mission and/or pass.

SOFTWARE REQUIRED

The following software is required:

a. COUNTDOWN Program, SCAN 6-049 (R)

b. COST Program, SCAN 6-038 (R)

c. CERTS Program

d. MSFTP-2 Decom SEQ 51, TESOC 1-051

EQUIPMENT CONFIGURATION

a. To perform the following tests, the equipment being tested must be in mission configuration:

(1) HSP

(2) UDB

(3) GMT.

(4) CAGE.

(5) GMT

(6) TCT

(7) MTU

(8) ISA

b. The equipment configuration for the DTU, TTY, and PCM tests are shown in figures 2-28 through 2-30.

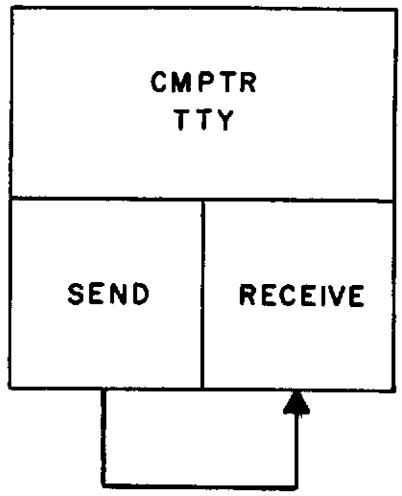


Figure 2-28. Typical TTY Subtest Configuration

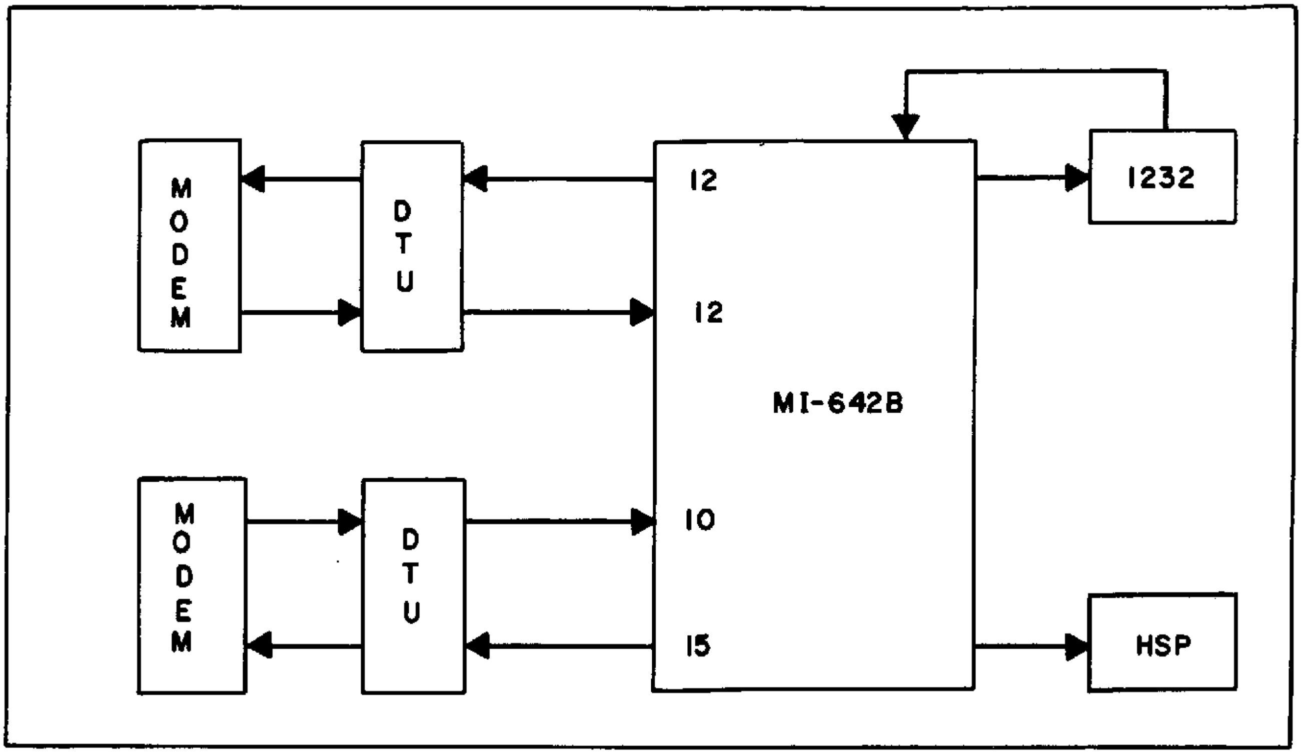


Figure 2-29. DTU Subtest Equipment Configuration

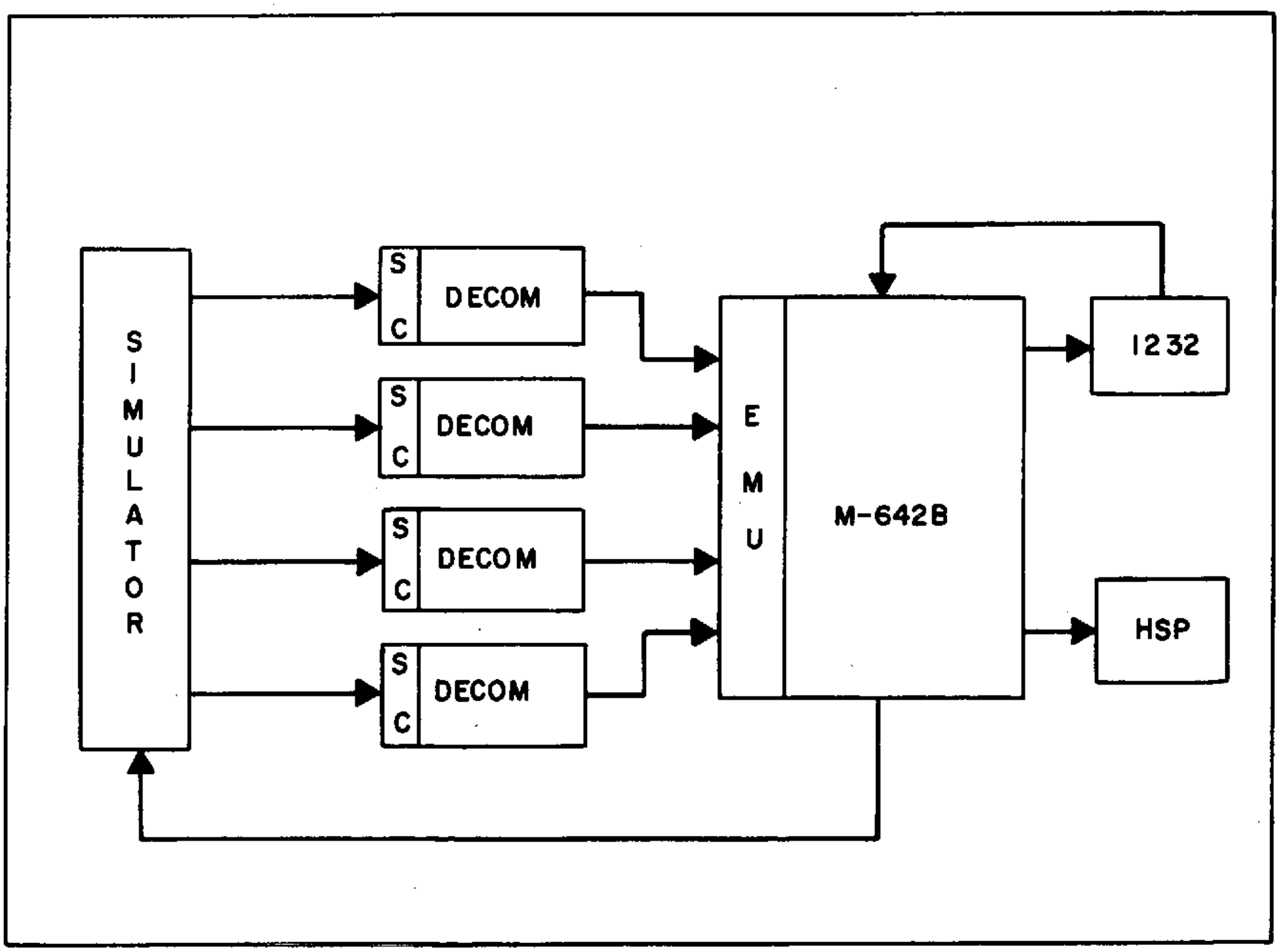


Figure 2-30. COST Tests Equipment Configuration

2.10.1 COST ERTS (CERTS) TEST

2.10.1.1 Equipment Setup

a. Using the procedures in SCAN, STDN No. 504, load the COST ERTS (CERTS) program into the computer designated for mission support.

b. Configure the antenna to radiate if clearance has been obtained; if not, radiate into the dummy load.

c. After the CERTS program has been loaded, remove the systems tape, clean the Magentic Tape Unit (MTU) heads, mount scratch tapes, set WRITE ENABLE, and select addresses 1 through 4 for the handlers being tested.

d. The Model 3000 Time Code Translator (TCT) controls must be set up as follows:

Control	Setting
Front panel control	
POWER	ON
CODE SELECT	2
SYNC MODE	Ø
FWD/REV	FWD
Internal subpanel control	
PLAYBACK	1
SEARCH	1

e. Set the following internal subpanel controls as indicated to perform the CERTS TCT subtest.

Control	Setting
MS/SEC	OFF
GEN/TRANS.	TRANS
TCT/TCG	TCT

2.10.1.2 CERTS Test Procedures. Perform the scripted sequences after ensuring that all equipment is properly configured.

Note

Close coordination is required between all personnel involved in this testing to ensure a speedy and successful test completion.

2.10.1.3 CERTS Test Script

Seq	Operator	Instructions
1	Computer	Load CERTS into the computer designated for mission support.
2	Computer	Set PROGRAM JUMP keys 1 and 2 up.
3	Computer	Start the computer. (Start address is P = 40000.)
4	Computer	Answer the initiation questions as they are printed out: **Printout** — **Answer** TYPE THE LAST TWO DIGITS OF THIS YEAR — 7X↑ COMPUTER: CMD OR TLM? — TLM↑ STATION CODE (TTY)? — YYY↑ TEST MODE: SYS, PRE, OR UNT — UNT↑ SUB-SYSTEM INSERTS? — GMT, HSP, TCT↑
5	Computer	Verify that the HSP output is legible and that no characters are missing. Verify that there is no time/sync discrepancy between the time code translator and the ISA-GMT as viewed on the HSP printout.

2.10.1.3 CERTS Test Script (cont)

Seq	Operator	Instructions
6	Computer	Upon completion of the HSP and TCT subtests, insert the DTU, CAG, ISA, MTU, and CST subtests. Refer to table 2-10 and figure 2-31 for CAM's and CAM combinations.
7	Computer	Delete the GMT subtest.
8	Computer/M&O	Verify that the HSP printouts for all tests are complete and the designated systems are Green.
9	M&O/Computer	Determine if any tests should be rerun.

Table 2-10. COST/CERTS-ISA CAM Combination

Item	CMD CAM	Octal CMD	Printout TLM	TLM CAM
1	Clear all latches CLEAR COMDEC 1 D H K PBI's 1, 2, 3 INITIATE	0411220443	1011220443	Clear all latches CLEAR COMDEC 1 D H K PBI's 1, 2, 3 INITIATE
2	Clear all latches CLEAR COMDEC 2 E I J G PBI's 4, 5, 6 INITIATE	0422112126	1022112126	Clear all latches CLEAR COMDEC 2 E I J G PBI's 4, 5, 6 INITIATE
3	Clear all latches CLEAR CIU COMM CRIT Comm I D Uplink PBI's 7, 8, 9 INITIATE	0445463611	1045463611	Clear all latches CLEAR CIU COMM CRIT Comm I D Uplink PBI's 7, 8, 9 INITIATE
4	Clear all latches CLEAR COMDEC 2 G J E PBI's 0, 0, 0 INITIATE	0422115252	1022115252	Clear all latches CLEAR COMDEC 2 G J E PBI's 0, 0, 0 INITIATE

COMDEC 1 A	D	H	1	6
COMDEC 2 B	E	I	2	7
CIU COMM C	CRIT COMM F	J	3	8
CLEAR	G	K	4	9
INITIATE	ERROR	UPLINK L	5	Ø

Figure 2-31. ERTS CAM

2.10.2 COST TEST

2.10.2.1 Equipment Setup

a. Load sequence 51 into the decoms. Stations will set the frame synchronizer switches for the data set as specified by ERTS Ops for the upcoming pass. Frame synchronizer switch settings for all other performances of the SRT COST test will be as specified for data set No. 1. Switch settings for all data sets are specified in STDN No. 601/ERTS. Use the simulator formats as specified in the input/output (I/O) console printout.

b. Configure the Unified S-band transmitter to radiate into the antenna if radiation clearance has been obtained; if not, radiate into the dummy load.

c. Vérify that power is applied to the SDDS-IN-LOCK ENCODER, and press the CLEAR PBI (USB backup stations only).

d. To prepare the Updata Buffer (UDB) for testing, perform the following:

(1) At the Maintenance and Operations (M&O) console, set the OPERATE/SAFE switch to OPERATE.

(2) At the UDB, set the OPERATE/TEST switch to OPERATE, and the VR switch to VR-1.

e. After the COST program has been loaded, remove the systems tape, clean the MTU's, mount scratch tapes, set WRITE ENABLE, and select addresses 1 through 4 for the handlers being tested.

Note

> Close coordination is required between all personnel involved in this testing to ensure a speedy and successful test completion.

f. Briefly record the DAC outputs on the stripchart recorder (refer to para 2.2.1.4) during the performance of the COST PCM subtest.

2.10.2.2 Test Procedures. Use the following procedures to perform the RSDP and peripheral equipment test (COUNTDOWN/COST testing).

RSDP and Peripheral Equipment Test Script

Seq	Operator	Instructions
1	Computer	Clear core, set all computer and EMU EI inhibits.
2	Computer	Load the COUNTDOWN program into both computers via BOOTSTRAP II.
3	Computer	Monitor the 1232 I/O consoles and the computers for 4-STOP's.
4	Computer	After each 4-STOP, start the computer(s).
		Note Computers will not 4-STOP waiting for operator to set the RTC switch down.
5	Computer	After completion of the COUNTDOWN program, load the COST program into computer.
6	Computer	Answer the initiation questions as they are output: 1232 Printout — Answer TYPE THE LAST TWO DIGITS OF THIS YEAR — XX ↑ COMPUTER: CMD OR TLM — XXX ↑ STATION CODE (TTY)? — YYY ↑ TEST MODE: SYS, PRE, OR UNT? — UNT ↑ SUB-SYSTEM INSERTS? — HSP, TCT ↑ THANK YOU!

RSDP and Peripheral Equipment Test Script (cont)

Seq	Operator	Instructions
7	Computer	Verify that the HSP printouts are complete and legible.
8	Computer	Verify that there is no time/sync discrepancy between the time code translator and the ISA-GMT as viewed on the HSP printout.
9	Computer	Insert the following subtests singly or together under TC direction as follows: "INS, GMT, MTU, DTU, TCT, ISA, CST, UDB †" (Use CAG instead of UDB for ULA only.)
10	M&O	Initiate CMD and TLM CAM's as outlined in table 2-8. Refer to figure 2-33 for CAM labeling.
11	AM&O/ Computer	Verify correct indicator combinations on the SOC console for CMD computer modes during CMD CAM initiations, and the HSP printouts for all M&O CAM operations. Refer to table 2-8.
12	Rec/Exciter	Rotate the MODE SELECTOR switch through all modes, pausing momentarily at each position, then return the switch to its original position.
13	USB/SDDS	Press the SDDS-IN-LOCK-ENCODER PBI's (CSM then LM, SDDS 1 and 2 for the parameter that is in-lock). At the 85-foot antenna stations, perform this sequence for SDDS-IN-LOCK-ENCODER PBI's 1 through 4.
14	TC/M&O/ Computers	As each subtest is completed, delete the test, and monitor the HSP and I/O console for the test results.

RSDP and Peripheral Equipment Test Script (cont)

Seq	Operator	Instructions
15	TC/PCM/ Computers	Sequences 16 through 19 should be performed only after BER testing is completed using the PCM simulator and the signal conditioners.
16	PCM/ Computers	To perform simulator load type in: LOD, SIM ↑ To insert PCM subtest, type in: INS, PCM ↑ Verify correct decom lock for each PCM step/vehicle stream (refer to table 2-8) and notify TLM computer when ready.
17	PCM/ Computers	Perform PCM steps 5 and 6 only.
		Note Perform test steps only for vehicles active on that day of support.
18	Computers	Verify that the channel indicators light on the EMU for the decom(s) selected to input data for the step specified. Notify TC and PCM when the selected PCM step is completed.
19	TC/M&O/ Computers	Check all printouts and take appropriate action because of failures, if necessary. Rerun any tests required to confirm readiness for mission support.
		Note If no reruns are necessary, or as tests are completed the equipment operators should be notified.

2.11 ACQUISITION BUS SLAVING

OBJECTIVES

The objectives of these tests are to verify that all systems can slave to the acquisition bus and that each system in turn, except the CMD antenna, can be the slaving source. During this test the USB may not reach the check points as rapidly as other systems, because of its slower slew rate.

Note

Each slavable antenna required for the mission will be positioned by each of the slaving sources to check for slaving accuracy. The Acquisition Bus Monitor (ABM) will be test conductor for this test.

2.11.1 STATUS INDICATIONS (USB STATIONS)

2.11.1.1 At each source of tracking data, except USB, initiate TARGET A assignment closures. The corresponding indicators on the ABM panel and the M&O console should light.

2.11.1.2 Repeat step 2.11.1.1 using TARGET B mode.

2.11.1.3 AA1 and AA2 initiate TLM No. 1 and TLM No. 2 closures. Corresponding indications should appear on M&O console status panel.

2.11.1.4 Request that each tracking data source in turn, except USB, autotrack in TARGET A mode. Corresponding indications should appear on the ABM panel and the M&O console. Also valid track indications should appear on the acquisition control panels.

2.11.1.5 Repeat step 2.11.1.4 using TARGET B mode.

2.11.1.6 Request that each tracking data source in turn except USB, initiate a slave mode of operation. Corresponding indications should appear on the ABM panel and the M&O console.

2.11.2 SLAVING TEST

The systems slaving check points will be 45, 135, 225, and 315 degrees azimuth (or four points 90 degrees apart) and 15, 30, 60, and 90 degrees elevation, and in the case of X-Y the check points will be -X and -Y, then +X and +Y. Each system slave test will begin at 270 degrees (or station zero cable wrap). As the USB will not indicate position to the ABM, the ABM will have to confirm each check point on the ABM loop.

2.11.2.1 USB Antenna

a. All slavable antennas select acquisition bus source antenna, slave to it, and then acknowledge slaving operation.

b. Manually rotate source to check points noted in step 2.11.2.

c. All positions report to ABM to verify smooth followup.

2.11.2.2 85-Foot Antenna Source. Repeat step 2.11.2.1 using the 85-foot antenna as the slave source.

2.11.2.3 40-Foot Antenna Source. Repeat step 2.11.2.1 using the 40-foot antenna as the slave source.

2.11.2.4 C-band Radar

a. Repeat steps 2.11.2.1b and c using the C-band radar No. 1 as the slave source.

b. Repeat steps 2.11.2.1b and c for C-band No. 2.

2.11.2.5 GRARR. Repeat steps 2.11.2.1b and c using GRARR as the slave source.

2.11.3 STATIONS WITHOUT NORMAL ACQ BUS

During the antenna slew, stations without the normal acq bus will slave antennas to monitor smooth track.

DATA SHEET

ACQUISITION BUS SLAVING

MISSION NO.__________STATION________OPERATOR________DATE___________

ANTENNAS

MASTER_________SLAVE 1__________SLAVE 2_________SLAVE 3_______________

TIME START______________________TIME END____________________

MASTER X^o	SLAVE 1	SLAVE 2	SLAVE 3		MASTER Y^o	SLAVE 1	SLAVE 2	SLAVE 3

MASTER AZ^o	SLAVE 1	SLAVE 2	SLAVE 3		MASTER EL^o	SLAVE 1	SLAVE 2	SLAVE 3

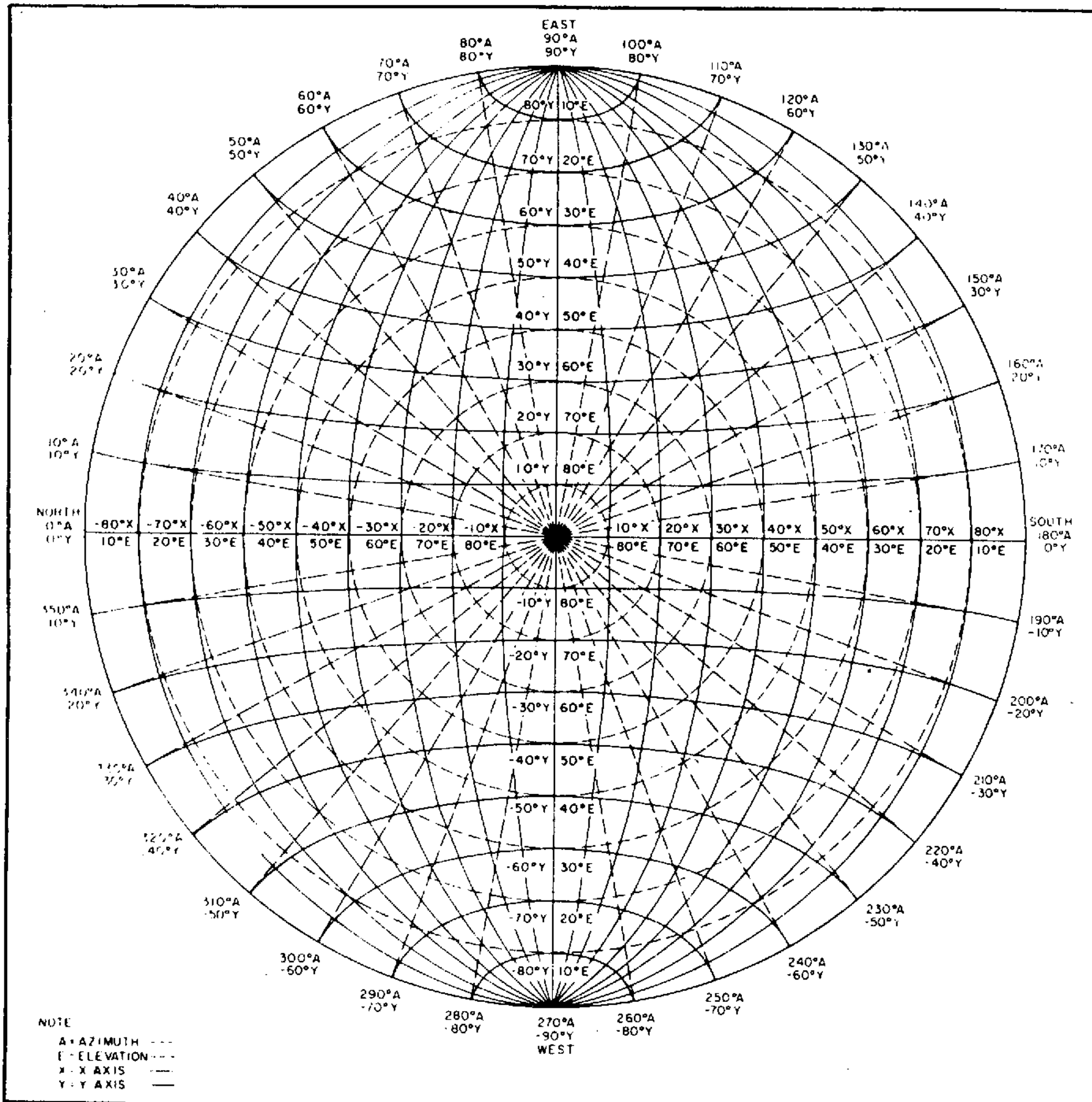


Figure 2-32. Azimuth-Elevation to X-Y Conversion Chart for ERTS Prime and 85-foot USB Stations

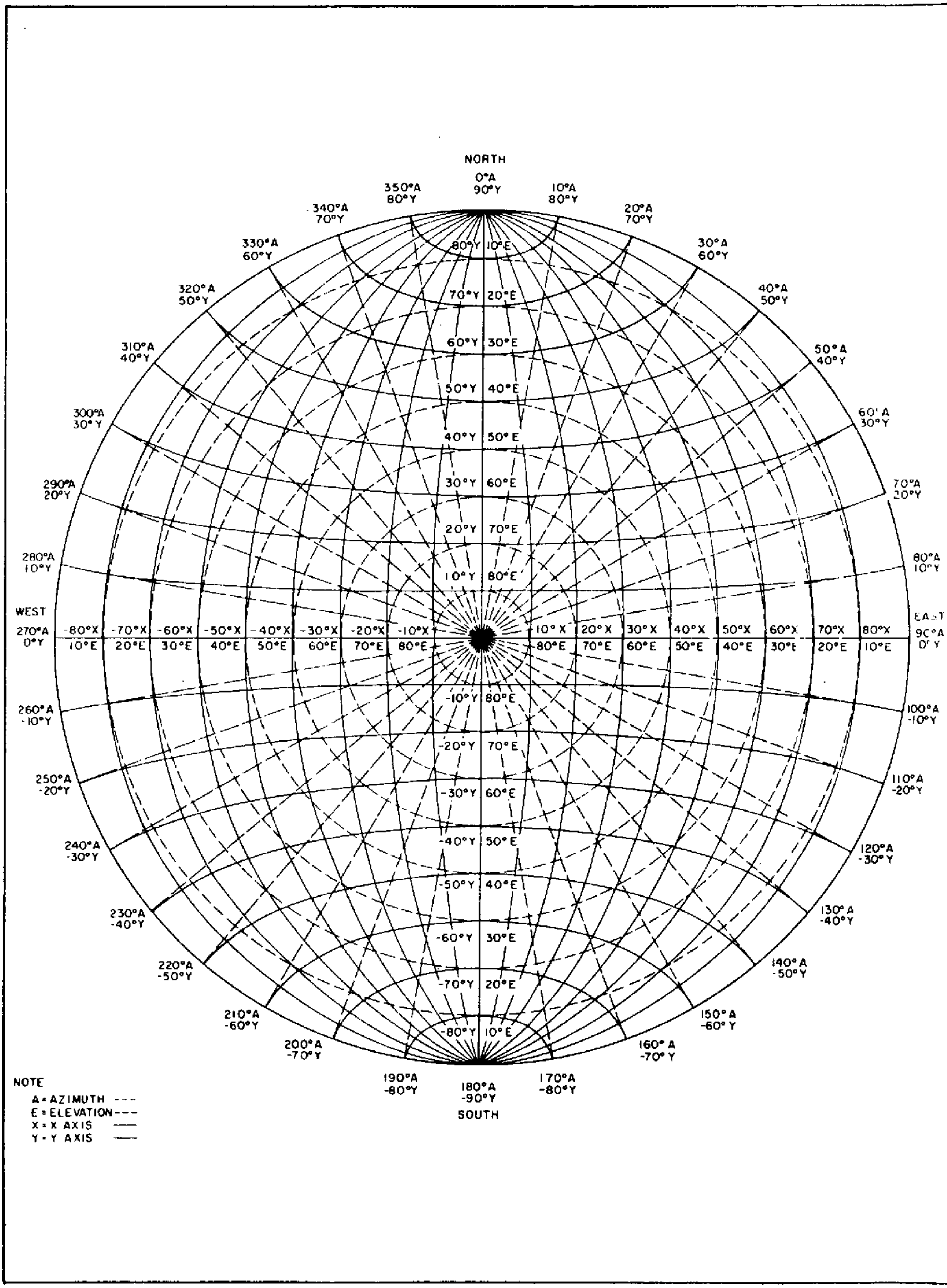


Figure 2-33. AZ-EL to X-Y and X-Y to AZ-EL Conversion Chart

2.12 TRACKING RADAR SYSTEMS

OBJECTIVE

The objective of these tests is to confirm that the radars are ready to support the immediate mission.

This test will verify that the radars can:

a. Transmit required power level at the mission frequency.

b. Receive the mission frequency with a noise figure and sensitivity that equals or exceeds mission requirements.

c. Lock on and track. The angle servo response and angle error gradient meets mission requirements.

d. Output angle and range information to the data processing system.

e. Be designated by its acquisition sources.

f. Transmit high-speed tracking data to GSFC.

2.12.1 FPQ-6 RADAR

WARNING

Performance of this test requires exposure to voltages which can result in injury to personnel. Observe safety precautions.

2.12.1.1 Transmitter

a. Operate all necessary switches, relays, and circuit breakers to cause the radar to operate single pulse with PRF and pulse width applicable to the designated mission. If no mission PRF is designated, operate the radar single pulse, 160 PRF, 1.0-μsec pulse width, 5690 MHz. Check the controls and/or indicators for the correct values as listed below.

Controls and/or Indications	Nominal Value
RF Amp Cabinet	
Focus coil current	10 to 12.5 amps
Klystron filament current expected value	1.30 to 1.325 amps
Modulator Cabinet	
Water coil milliamps	Less than 9 mA
5918 filament volts (all four positions of FILAMENT switch)	10 to 11.5 Vac
Bias kilovolts	-800 ±80 Vdc
	-1000 ±100 Vdc
TPA Cabinets	
6920 filament volts	10.8 to 12 Vac
2 kV supply	2 ±0.1 kV
16 kV supply	15 ±0.5 kV
16 kV supply current	15 to 100 mA
Control Power Supply Cabinet	
Klystron average milliamps	10 to 170 mA
Modulator average amps	0.1 to 1 amp
HV kilovolts	28 to 30 kV
Exciter Cabinet	
1st RF amplifier current	45 to 50
15 kV supply	Optimum detection RF output waveform
2nd RF amplifier cathode current	Less than 4 mA

b. Using the wavemeter, measure the transmitter frequency and adjust, if necessary.

c. Using the Power Monitor, measure the transmitter output power. Using the Power Monitor charts, convert the transmitter power to peak power.

d. Using either the internal monitor oscilloscope or an external oscilloscope connected to the RF monitor (through a detector), check the pulse width and code spacing, if applicable. There should be little, if any, discernible difference between the first and second pulse amplitudes of the coded pulses. Nominal width is ±10% at 70% amplitude.

2.12.1.2 Receiver

a. Place the radar in STANDBY mode. Manually tune the skin Local Oscillator (LO) to receive appropriate transmitter frequency and the beacon LO to receive appropriate beacon reply frequency.

b. Check skin AFC as follows:

(1) Position the antenna to a range target and adjust the MFC for maximum signal. Using the transmitter variable attenuator, reduce the received signal to present approximately 15 to 25 dB S/N on the monitor console.

(2) Change to AFC. No signal degradation should occur.

(3) Change to MFC and, using the wavemeter as an indicator, offset the frequency of the skin LO +3 MHz. Change back to AFC and note the AFC pull-in time. Repeat using -3 MHz offset. Maximum allowable time is one second.

c. Check beacon AFC as follows:

(1) Position the antenna to the boresight tower, and adjust MFC for maximum signal. Adjust the boresight signal generator for an indication of 25 dB S/N on the monitor console.

(2) Change to AFC. No signal degradation should occur.

(3) Change to MFC and, using the wavemeter as an indicator, offset the frequency of the beacon LO +3 MHz. Change back to AFC and note the AFC pull-in time. Repeat using -3 MHz offset. Maximum allowable time is one second.

d. At the receiver control indicator, check the Ref, AZ, and EL receiver crystal currents. They should be between 0.2 and 0.4 mA.

e. Record the receiver MDS using signal equal to noise for the 0 dB reference level. Record receive bandwidth used during this measurement. The sensitivity readings should be within ±2 dB of the sensitivity readings recorded in the last system test.

f. Perform noise figure measurements for the Ref, AZ, and EL channels. They should be 9 dB max (with paramps, 4 dB max).

g. Position antenna 1 mil off axis from the boresight tower. With PA off, check for proper alignment of the receiver IF phase shifter and RF shifters and correct error gradients. Turn paramps on and adjust for proper gain (18 dB) in all channels.

2.12.1.3 Angle Tracking

a. With hydraulic package under power and in the automatic mode, ground the AZ and EL valve drive inputs and balance the following in both AZ and EL servo loops: compensation amplifier, amplifier-integrator, rate amplifier, and discharge capacitors (in equalized and switching units). They should be balanced to ±0.01 Vdc.

b. Position the antenna 1 mil off axis from boresight and then place pedestal in preload. Lock on boresight and adjust track KV in angle error amplifiers for 7.5 V at J6006.

c. While in STANDBY mode and TEST status, cause the radar to lock on the boresight tower. Record AZ and EL readings; they should not deviate from survey parameters.

d. Position the antenna beam 1 mil high and 1 mil right relative to the boresight lockup coordinates. The AZ and EL voltage errors in beacon and skin modes as indicated on the oscilloscope adjacent to the waveform select panel or on the lag error meters, should be 10 Vpp.

e. Position the antenna 3 mils low and 3 mils left of the boresight tower and press the MANUAL LOCK ON pushbutton. The system should slew to the boresight tower. Repeat the procedure moving the antenna 3 mils high and 3 mils right. In both cases, the pull-in time should be within 2 seconds and in each case no more than one slight overshoot should be discernible.

f. Place the antenna in the PLUNGE position locked on the boresight tower. Note the AZ and EL readings and check for nominal.

2.12.1.4 Designation (Slaving). Verify that the designation and acquisition bus displays are operational and that the system is ready to support an acquisition bus test.

2.12.1.5 Ranging DIRAM

a. Verify the operational modes in which the range subsystem threshold adjustments are to be optimized.

b. Verify that the master oscillator generates a frequency of 5.25 MHz. Also measure the frequency of the clock pulse generator and the AUX TRACK oscillator.

c. Balance the error bridge.

d. Adjust acquisition MGC level.

e. Adjust A/D integrator balance.

f. Using the boresight tower signal generator, check the AUX TRACK detection threshold. Observe the AUX TRACK discriminator balance when locked on noise.

g. As in step 2.12.1 5f, check the DIRAM detection theshold. Note the number of correct "range verified" indications out of three consecutive tests. Commence each test from a different zone.

h. Check the ability of the system to transfer from AUX TRACK to DIRAM at the AUX TRACK threshold as determined in step 2.12.1.5f. Note verified tries as in step 2.12.1.5g. Note the minimum useable RANGE SERVO BANDWIDTH switch position.

i. Verify correct operation of the auto beacon phaser if it is to be used.

j. Insert a range rate velocity (control fully clockwise) and check the ability of DIRAM to acquire a 10-dB and a 35-dB boresight signal. Note the minimum useable RANGE SERVO BANDWIDTH switch position.

k. Observe the range discriminator balance using pulse widths of 2.4, 1.0, 0.5, and 0.25 μsec.

l. Lock on frequency shift reflector and check for correct range readout reading in skin gate.

m. Using frequency shift reflector, note and, if necessary, set in the beacon delay.

n. Verify that system does not lock up on noise in acquisition mode in 30 seconds.

2.12.1.6 Range ADRAN (BDA Only)

a. Verify the operational modes in which the ADRAN threshold adjustments are to be optimized.

b. Check for proper waveform of the 5.25-MHz phase A and phase B clock pulses. Check 5.25-MHz clock pulses for remote synchronization if applicable.

c. Lock onto the boresight tower and with a 40- to 50-dB S/N target, monitor the gated video at 1A10A4A1-J22 for a negative 0.75-volt video return. Adjust AGC circuits if necessary.

d. Place the pedestal in preload mode and lock the range on noise. Check the range discriminator for 0-volt balance at 1A10A4A11-J20 for the bandwidths to be used.

Note

Verify that the receiver bandwidth appropriate for the transmit pulse width has been automatically chosen.

e. Position antenna to range target and lock on to the FSR. Check for proper range reading in skin gate and then switch to beacon gate and adjust for the proper beacon delay reading.

f. Position the antenna to boresight. Lock AUX TRACK on noise and adjust AUX TRACK balance for minimum gate drift on the console range display.

g. Adjust the ADRAN ungated and nontrack video levels. Adjust the boresight signal for 10 dB S/N. Check for AUX TRACK lock-on with 10-dB signal, and verify no noise lock-on in 30 seconds. Select AUX TRACK auto reacquisition ON; adjust AUX TRACK first threshold on 2AGA7-R1 for proper sniff rate without targets. Verify that the system is reacquiring automatically when the boresight targets are jump phased.

h. Check for proper operation of multiple gates with 10-dB signal.

i. Adjust guard gate/find/verify video threshold for proper operation with 15 dB S/N from the boresight tower.

j. Check ADRAN sync mode as follows:

Note

If the FPQ-6 is master and the FPS-16 is remote, perform steps 2.12.1.6j (1) through (3).

If the FPS-16 is master and the FPQ-6 is remote, perform steps 2.12.1.6j (4) through (6).

(1) Turn on FPS-16 transmitter and operate it in the remote sync condition. Lock on range target and record range reading.

(2) Turn off FPS-16 transmitter. Turn on FPQ-6 transmitter; FPS-16 lock on range target using FPQ-6 return.

(3) Adjust the FPQ-6 transmitter delay (A9A4A11-DL2) for same range reading as obtained in step 2.12.1.6j (1).

(4) Turn on the FPQ-6 transmitter and operate it in the sync condition. Lock on range target and record range reading.

(5) Turn off the FPQ-6 transmitter and turn on the FPS-16 transmitter; FPQ-6 lock on the range target using the FPS-16 return.

(6) Adjust the FPS-16 transmitter delay (A4A3A1-DL2) for the same range reading as obtained in step 2.12.1.6j (4).

k. Check interference region operation as follows:

(1) Turn on FPS-16 remote sync.

(2) Lock both radars on FPQ-6 simulator target using the FPQ-6 boresight.

(3) Track the target through several interference regions with the target moving inbound and outbound. No dropouts should occur entering, during, or leaving the interference region.

l. Check auto phasing operation as follows:

(1) Position both the FPQ-6 and FPS-16 antenna to the range target. Energize the transmitters and lock on the respective range target returns.

(2) Select auto phasing ON; observe proper modulation trigger position in the range video display. Each radar should rephase every second.

2.12.1.7 Computer. The computer TAMP tape should be played through at this time.

2.12.1.8 TTY Data Flow Test

a. Ensure that the FPQ-6 radar digital data systems are energized and operating properly.

Note

The FPQ-6 radar should be set up in the operational mode to be used.

b. Ensure that the 4101 computer is energized and loaded with the proper program.

c. Lock the radar on the boresight tower return. Check the TTY printout for correct data.

2.12.1.9 Data Start Transmission Code

a. On the receiver control panel (9A9A2A10), select DD with the LSD routing pushbuttons. Verify that the DD portion of the pushbutton lights.

b. On the memory display panel (9A1A1), select memory address for ID word 3. Verify that bit 11 is present when DD is selected.

2.12.1.10 Data Recording

a. Lock the system to the boresight tower. Activate the magnetic digital data recording equipment, TTY, and the flexowriter; record several readings.

b. Place the digital recording equipment in read mode and play back the information just recorded on the flexowriter and TTY. Compare the flexowriter and TTY outputs with those printed in step 2.12.1.10a.

2.12.1.11 Timing

a. Check the following test points for proper waveform and amplitude:

Test Point	Waveform	Amplitude
B23-TP2	1 MHz	8 Vpp
B24-TP2	1 MHz	8 Vpp
D2-TP2	1 MHz	12 Vpp
D2-TP4	1 MHz	12 Vpp
A24-TP2	Symmetrical Square Wave	N/A

b. Using internal sync mode and DC input, observe the waveform at A24-TP3 and A24-TP1 simultaneously (see figure 2-34).

c. The peak of the pulse should fall midway between the peaks of the modulated and unmodulated sine waves.

d. The pulse width should touch or be the same as the width of the sine wave at the pulse peak.

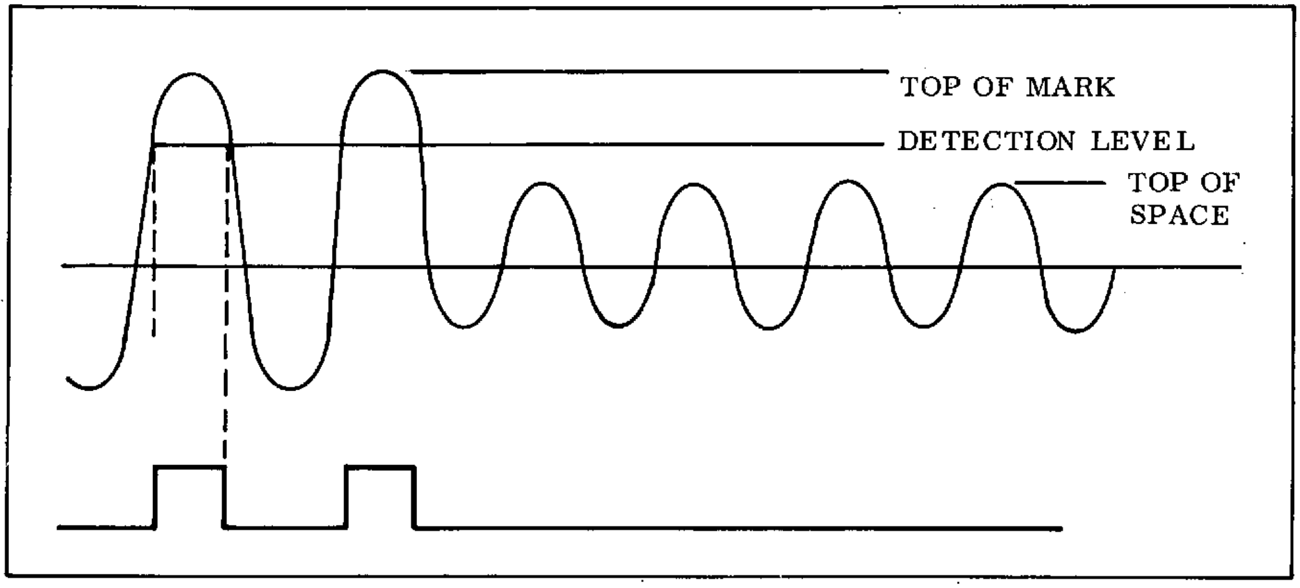


Figure 2-34. Timing Waveform

e. Sync the oscilloscope on the USB 1 pps and observe the Astrodata 1 pps at C18-TP1 or TP2. Verify the time delay in between 3 and 5 μsec.

f. Sync oscilloscope external with the USB 1 pps timing and check the following test points:

Unit Test Point	Delay
Astrodata C18-TP1	3 to 5 μsec
Astrodata C18-TP2	3 to 5 μsec
Datatron 1 pps (front panel)	5 to 35 μsec

2.12.1.12 Analog Data

Note

This section applies only to those stations with analog plotting boards.

a. Select the proper range scale on the range D/A and scale up the plotboard to the preplotted chart.

b. Select 10 points for the pointing data printout. Position the radar antenna to each of these points and cause pens to place a mark on chart. On preplotted chart, marks occur within 1/4 inch of line. Leave chart on board.

2.12.2 FPS-16 RADAR

2.12.2.1 Preliminary

a. Check all power supplies and line voltages. Adjust if necessary.

b. Check waveguide pressure and blowers.

c. (VAN only) Check the hydraulic/hydrostatic refrigerant cooling.

2.12.2.2 Transmitter

a. Check the following driver power supply voltages for their proper reading.

Filament	11.5 Vac
-800 V	-800 ± 100V
-1000V	-1000 ± 100V
+2000V	+1600V ±100V

b. Energize transmitter and check the high voltage power supply. Voltage should be between 30 and 34 kV.

c. Check magnetron cathode current.

d. Measure and calculate peak power output in single pulse and 160 PRF. Minimum power should be 1 MW.

e. Using wavemeter, check that operating frequency is set for mission requirement.

f. Using a spectrum analyzer, check the amplitude of the side lobes and for double moding, pulling or any other spectrum abnormalities. The first side lobe should be at least 10 dB down from the main lobe.

g. Check the beacon pulse coder and verify that correct spacing and code is selected for mission requirement.

2.12.2.3 Receiver

a. Ensure that the skin and beacon local oscillators are tuned to the correct operating frequency to satisfy mission requirements.

b. Check crystal currents. Crystal currents should be 0.5 ± 0.1 mA, and pairs should be as closely balanced as possible.

c. Measure noise figure for Ref, AZ, and EL channels. Maximum allowable noise figure is 4 dB.

d. Position the antenna 1 mil off axis from the boresight tower. Check for proper alignment of the receiver IF and RF phase shifters.

e. Check for proper gain of the receiver paramps. Gain should be 18 dB in all three channels.

2.12.2.4 Angle Servo

a. Check manual slew and handwheel controls. Ensure position indicators and digital readouts operate properly.

b. Slave to optical tracker, position the antenna in AZ and EL, and ensure proper operation in both axes.

c. Lock on noise and ensure proper error balance.

d. Offset antenna 1 mil in AZ and EL from boresight tower. Lock on point and measure error gradient. Error signal should be 10 V/mil.

e. With antenna at a 1 mil offset, lock on the boresight tower signal and check lock on response using error recorder. Maximum allowable overshoot is 25 percent on the first overshoot and settling time of one and one-half overshoots in 1/4 second.

2.12.2.5 Range

a. Verify that range can be slewed from the console. Octal readout should be smooth with no jumping.

b. Lock on noise and check range gate drift. There should be no gate drift within 30 seconds.

c. Check for proper lock-on in all acquisition modes utilizing a moving target of 10 dB S/N and 10 kyds/sec velocity. Track through one range interval and ensure proper operation.

d. Check ADRAN sync mode as follows (BDA only):

Note

If the FPS-16 is master and the FPQ-6 is remote, perform steps (1) through (3).

If the FPQ-6 is master and the FPS-16 is remote, perform steps (4) through (6).

(1) Turn on the FPQ-6 transmitter and operate it in the remote sync mode. Lock on the range target and record the range reading.

(2) Turn off the FPQ-6 transmitter and turn on the FPS-16 transmitter. Lock on the range target with the FPQ-6 using the FPS-16 return.

(3) Adjust the FPS-16 transmitter delay (A4A3A1-DL2) for the same range reading as obtained in step (1).

(4) Turn on the FPS-16 transmitter and operate it in the remote sync mode. Lock on the range target and record the range reading.

(5) Turn off the FPS-16 transmitter and turn on the FPQ-6 transmitter. Lock on the range target with the FPS-16 using the FPQ-6 return.

(6) Adjust the FPQ-6 transmitter delay (A9A4A11-DL2) for the same range reading as obtained in step (4).

e. Check interference region sync as follows (applicable when FPS-16 is in sync mode) BDA only:

(1) Turn on FPS-16 remote sync.

(2) Lock both radars on FPQ-6 boresight tower using the FPQ-6 target simulator.

(3) Track the target through several interference regions with the target moving inbound and outbound. No dropouts should occur entering, during, or leaving the interference region.

f. (VAN Only) Set DATA VALID switch to ON. Confirm with CDP that following indicators are lit:

(1) RANGE VERIFY

(2) ON TRACK

(3) AGC

(4) DATA VALID

(5) CORRECT OBJECT

(6) ID

2.12.2.6 Digital Data

a. Set D/TT 165 Converter POWER switch to ON. POWER indicator should light.

b. Check all metered voltages. Adjust as required.

c. Check timing readout of the D/TT 165 equipment.

d. Set vehicle tracking identification thumbwheel switch in each position. Verify that proper code for each vehicle is placed in the data format. Return thumbwheel switch to proper vehicle code.

e. Stations with EI 3504 implemented and using the 38-character format, check the operation of the mission ID switch by setting switch to mission A and start the D/TTY converter. Verify that character 15 (12th character from left) is between 0 and 3.

f. Set mission ID switch to mission B. Verify that character 15 changes and is now between 4 and 7.

g. Return switch to mission code specified for next pass.

2.12.2.7 Operational Checks

a. Lock on boresight tower and verify that angles and range are correct (same as surveyed).

b. Lock on range target and verify that range readouts are correct.

c. (VAN Only) Set up signal generator for a 10-dB signal (injected through transmitter coupler). Sync the generator to range simulator and set for 32,000 nmi range. Press FIND/VERIFY pushbutton. Check that correct range is verified.

d. Stations having boresight signal generators with moving target capability, set up 10-dB S/N target at Kyds/sec (inbound, then outbound).

e. Lock on to moving target and track.

f. Check manual phasing. Range should not break track.

g. Check IRACQ transfer of 10-dB S/N target at 10 kyds/sec.

h. Check multigate on 10-dB S/N target at 10 kyds/sec.

i. Lock on in wrong range interval. Press FIND/VERIFY pushbutton. Ensure that correct range is verified.

2.12.2.8 Simulated Radar Inputs and Data Verification

Note

This section applies only to those stations using MILGO 165 D/TTY converters.

a. Set D/TTY 165 control as follows:

Control	Setting
TEST MODE	PATT A
TTY 1	ON
TIME	EXT

b. Press START pushbutton; 28 RO printouts should read as follows:

HEADING	TIME	AZIMUTH	ELEVATION	RANGE
8XXX0	193759	000000	000000	0000000
Stations with EI 1572				
8XXX0	193759	0000000	0000000	000000000

c. Press STOP pushbutton. The last printed line should read as follows:

HEADING	TIME	AZIMUTH	ELEVATION	RANGE
9XXX0	193759	000000	000000	0000000
Stations with EI 1572				
9XXX0	193759	0000000	0000000	000000000

d. Set TEST MODE switch to PATT B.

e. Press START pushbutton; 28 RO printouts should read as follows:

HEADING	TIME	AZIMUTH	ELEVATION	RANGE
8XXX2	264826	377777	377777	3777777
Stations with EI 1572				
8XXX2	264826	1777777	1777777	177777777

f. Press STOP pushbutton. The last printed line should read as follows:

HEADING	TIME	AZIMUTH	ELEVATION	RANGE
9XXX2	264826	377777	377777	3777777
Stations with EI 1572				
9XXX2	264826	1777777	1777777	177777777

Note

XX = Station ID X = Radar ID

g. Set TEST MODE switch to DATA.

h. Turn on DATA ACCEPTABLE control on radar console and lock radar on target. Check 28 RO for a 2 printout in the eighth data frame character (fifth character from the left). Check with ADC and GCC for valid indications on the ADC console and the RDCU.

i. Release DATA ACCEPTABLE control on radar console. Check 28 RO for a 0 printout in the eighth data frame character.

j. Check for time printout in steps of 6 seconds beginning at 0 second.

k. Perform the following procedure:

(1) Position the antenna to zero degrees in azimuth and elevation.

(2) Select the TEST Mode at the MONITOR AND STATUS TEST PANEL (cabinet 100) of the main console.

(3) Start the low-speed TTY printer.

(4) Simultaneously depress the CW SLEW and RANGE A PRIORI buttons on the main console (cabinet 100).

(5) When an elevation angle of 70 degrees is reached, release the CW SLEW and RANGE A PRIORI buttons.

(6) Examine the data printout from the TTY printer and verify that the az, el, range, and time data progress sequentially in an ascending direction.

2.12.2.9 Data Start Transmission Code

a. Have GCC patch the reperforator to the FPS-16 low-speed output. Set routing switch to JJ position and start data. Verify that start-of-message group is as follows:

JJ

Letter shift

Carriage return

Line feed

Letter shift

b. Stop data and set routing switch to DD position. Start data and verify that start-of-message group is as follows:

DD

Letter shift

Carriage return

Line feed

Letter shift

c. (BDA only) Place routing switch in REMOTE position and verify that start-of-message group reads the same as the results in step 2.12.2.9a.

d. (BDA only) Energize remote/local relay and verify that start-of-message group reads the same as the results in step 2.12.2.9b.

2.12.2.10 Radar Dynamics Tests. Slew range, AZ, and EL at constant rates. Check 28 RO for progressive printouts and gross errors.

2.12.2.11 Plotboards

a. Set plotboard and polar-to-cartesian coordinate converter controls as follows:

Control	Setting
PEN ARMS	STANDBY
PENS	UP
INTERCHANGE	NORMAL
FOLDED PLOT	OFF
PARALLAX	OFF
PARALLAX ADJUST	OFF
VACUUM	OFF
RANGE	4 M YARDS
DATA SMOOTHING	HI

b. Verify that there is sufficient ink supply and that pen operation is correct.

c. Set plot paper on board and position paper properly. Set VACUUM switch to ON.

d. Verify that amplifiers on polar-to-cartesian coordinate converter and plotboard are balanced.

e. Step METER switch through each active position. For each position (except STABILITY position), meter should indicate 8 large divisions, ±2 divisions. In the STABILITY position, the meter should indicate 8 large divisions ±1 division.

f. For stations using preplotted charts, utilize scale factor and parallax correction from the preplotted chart. (Stations without preplotted charts skip this step and continue at 2.12.2.11g). Select 10 points from pointing data printout and position radar antenna to each of these points and make a pen mark on the chart. These plot points should be within 1/4 inch of preplotted line. Leave chart on board.

g. For stations without preplotted charts, use pointing data to determine appropriate scale factor. Set in the proper station parallax correction. Select 10 points from pointing data printout and position radar antenna to each of these points and make a pen mark on the chart. These plot points should form a smooth arc.

2.12.3 CAPRI RADAR

2.12.3.1 Preliminary

a. Operate all necessary switches and circuit breakers to cause system to be in the OPERATE mode.

b. Check all power supply status lights, equipment blowers, and air pressure gauges for proper indication. Adjust power supply voltage and air pressure regulator if not within tolerance.

2.12.3.2 Transmitter

a. Check magnetron and keyer tube filament voltage, verify correct voltage, and adjust if necessary.

b. Operate all necessary switches to cause the transmitter to operate single pulse with PRF and pulse width applicable to mission. If no mission is designated, use 640 PRF, 1 μsec pulse width, and 5690 MHz.

c. Check high-voltage power supply voltage. System should be able to achieve 30 kV without faulting. Return high voltage to nominal value (28 kV is typical).

d. Check magnetron cathode current. Verify that value is typical for high voltage setting and PRF.

e. Measure and calculate peak operating power in single pulse, 160 PRF. Minimum acceptable power level is 1 MW.

f. Check operating frequency using wavemeter; verify that it is the frequency specified for mission.

g. Connect spectrum analyzer and check magnetron spectrum. Check amplitude of first sidelobes (-10 dB minimum allowable for good magnetron), double moding, pulling, and any other spectrum abnormalities.

h. Check pulse coder. Verify that pulse amplitudes are equal in coded mode and are equal in amplitude to single-pulse mode. Verify that correct spacing and code is selected for beacon interrogation.

i. Repeat step 2.12.3.2g using double pulse.

2.12.3.3 Receivers

a. Verify that receiver BEACON LO and SKIN LOW are tuned to correct operating frequency. MFC is centered on this frequency and MFC width is set for correct range (±20 MHz).

b. Check crystal currents. Values of pairs must be 0.5 ±0.05 mA. Replace crystals if necessary.

c. Measure noise figure for REF, AZ, and EL channels. (Minimum acceptable is 4 dB with paramps, 7 dB with TDA, and 9.5 dB with only basic receiver.)

d. Measure minimum discernable signal (-100 dBm minimum is typical).

2.12.3.4 Tracking

a. To energize hydraulics, use both TEST and OPERATE mode, take control of antenna with handwheels, and verify that servo response is smooth and normal.

b. Lock on boresight tower signal and measure error balance. Error signal should be a null for balanced system.

c. Offset antenna 1 mil in each direction from boresight tower and measure error gradient. Gradient at servo chassis should be 10 V/mil.

d. Offset antenna 3 mil in azimuth and elevation. Select MANUAL lock on and check lock-on response for no more than 25 percent overshoot and minimum settling time (one and one-half overshoots). Use of error recorder is recommended for this check.

2.12.3.5 Range

a. Verify that range can be slewed from console. Digital display should be smooth with no jumping.

b. Check range gate drift by slewing range to middle of range interval and selecting LOCK-ON. Gate should not drift in either direction within first 10 seconds. Use the same operation mode, pulse width, and PRF that will be used for mission.

c. Lock on to moving target at 10 dB S:N and 10 kyds/sec velocity. Track through one range interval. System should maintain track.

d. Check coast function, with system tracking the boresight signal with a moving range. Interrupt signal for 30 seconds and verify that system locks again when signal is restored.

e. Lock on in wrong range interval. Press FIND AND VERIFY pushbuttons. Verify that correct range is verified.

2.12.3.6 Digital Data

a. Set D/TTY converter switch to ON and verify that equipment energizes.

b. Start printer and check for proper printout, verify that timing printout sample rate is once every 6 seconds.

c. Set VEHICLE TRACKING IDENTIFICATION thumbwheel switch to each position for proper printout. Verify that proper code for each vehicle is placed in the data format. Return switch to mission ID code.

d. Check remote start, place control unit in AUTO, lock system on valid target and verify that printer starts, prints the JJ header, and character 8 (fifth character from left) switches to a 2. Release lock-on and verify that character 8 changes to a 0. Stop data transmission and verify that character 7 (fourth character from left) switches from the vehicle ID to a 9 and the printer stops.

2.12.3.7 Data Start Transmission Code

a. At the tape and teletype control indicator panel (A1A8), select JJ position with switch A10 and press START/STOP pushbutton to start. Verify a JJ start-of-message code in the TTY format.

b. Press the START/STOP pushbutton to STOP and verify that characters in the stop code are unchanged.

c. Select DD and start message. Start-of-message code should contain DD in place of JJ.

d. Press START/STOP pushbutton to STOP and verify that characters in the stop code are unchanged.

2.12.3.8 Mission ID

a. At the TTY control indicator panel (A1A8), place MISSION ID switch in the 0 position. Verify that the MSB of character 15 is 0 in the TTY format.

b. Place MISSION ID switch in the 1 position and verify that the MSB of character 15 is 1 in the TTY format.

2.12.3.9 Data Handling

a. Energize magnetic tape unit; verify that equipment energizes. Clean tape head and capstan.

b. Ensure that tape is loaded and ready to record.

c. Energize function recorder and verify that equipment energizes. Visually inspect paper supply and pens.

d. Turn on all channels and run short burst of locked-on boresight tower at mission paper speed. Verify that the error recording on each channel looks typical.

2.12.3.10 Operational Checks

a. Lock on boresight tower and verify that angles are correct (same as surveyed ±4 octal bits).

b. Lock on range target and verify that range readouts are correct (same as surveyed ±2 octal bits).

c. Check manual phasing by viewing moving target not synchronized to radar. Verify that unsynchronized target is phased with respect to range gate. Lock on to moving target synchronized to radar and verify that radar holds track during phasing.

d. Check radar data outputs by restarting D/TTY equipment and slewing AZ, EL, and RANGE at CADFISS rates. Check the teletype printer output for progressive printouts and gross errors.

3.1 REAL-TIME DATA FLOW TESTS

There two real-time data flow tests:

a. ETC Dump and Real-Time Data Flow Test.

b. ULA, GDS, and Backup USB Stations Data Flow Test.

3.1.1 ETC ON-SITE DUMP AND REAL-TIME DATA FLOW TEST

OBJECTIVE

The objective of this test is to make an end-to-end check verifying that the NTTF ERTS station (ETC)/Operations Control Center (OCC) station configuration is correct and can support mission requirements. This will be a final check of hardware and software prior to network testing.

TEST DESCRIPTION

The test objective will be accomplished by flowing uplink data from the OCC via the modem/DTU, the 642B computer, CAGE, and RF system to the antenna, while injecting OCC-generated downlink data into the paramp. This data is flowed through the telemetry system at ETC and back to OCC for evaluation.

3.1.1.1 Test Setup

a. Configure ETC as shown in figure 3-1.

b. Set the test transmitter for -112 dBm into the parametric amplifier as measured on the receiver AGC.

c. Set up the individual subcarriers to phase modulate the test transmitter as follows:

Subcarrier		Carrier Suppression
Real-time	768 kHz	0.2 dB
Dump	597 kHz	1.5 dB
DCS	1.024 MHz	2.3 dB

d. Use the test script for either VHF or USB testing.

Note

Mode 2 operations script is in two parts and must be coordinated between OCC and ETC prior to test performance.

3.1.1.2 Test Procedures

a. CMD and TLM

(1) Load the ERTS operational program as given in SCAN 6-860 or 6-868.

(2) Patch SRT CMD and CLK tracks to the dc side of the receive modem.

(3) Verify that all required MTU's are loaded as specified in STDN No. 601/ERTS.

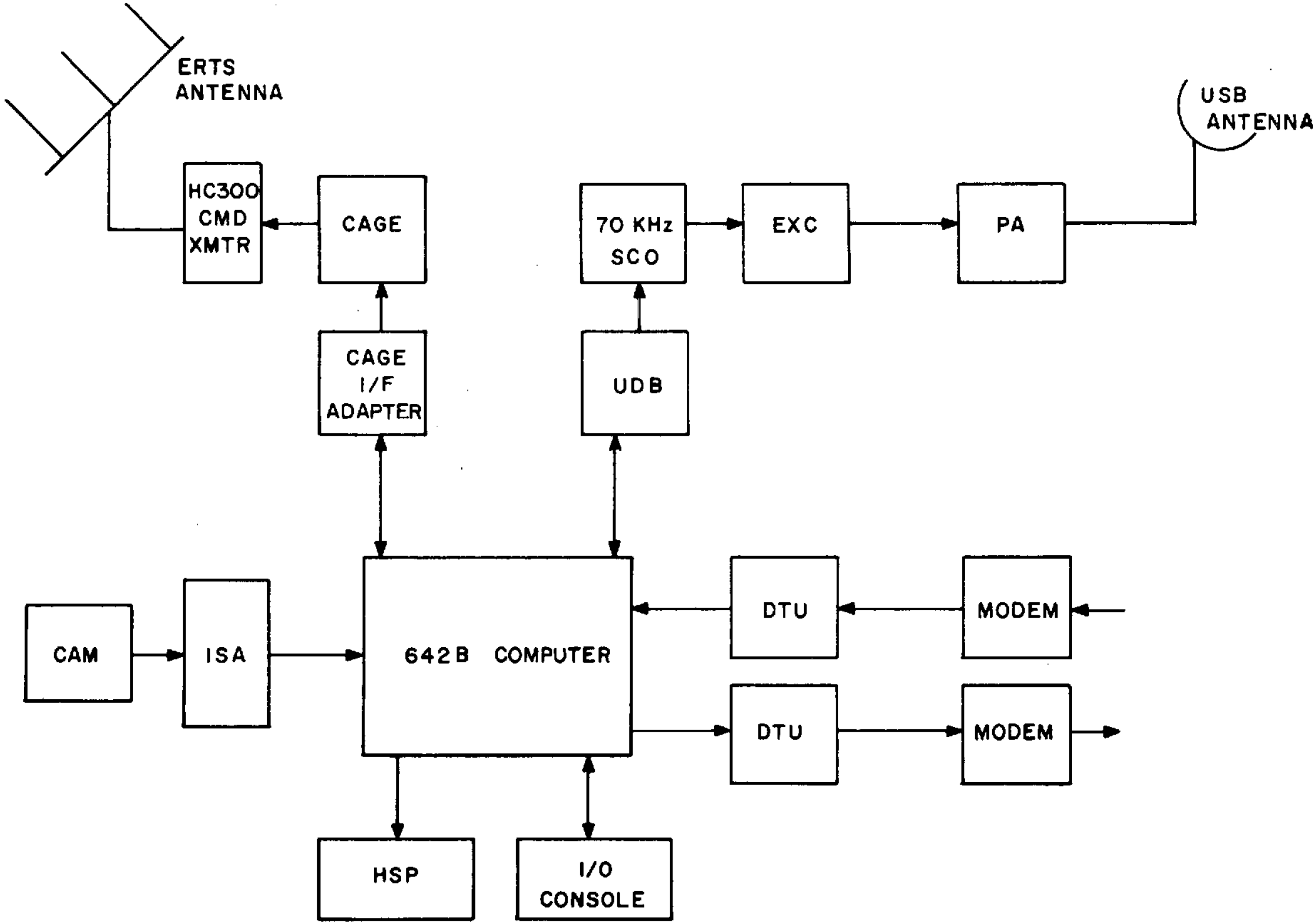


Figure 3-1. ETC Typical Configuration

(4) Bring up the CMD carrier and radiate into the antenna or dummy load, depending on radiation clearance.

(5) OPSR should verify the following (see figure 3-2)

(a) RF CMD system is operational.

(b) Computer is cycling and uplink mode is enabled.

(c) GCC has all high- and low-speed data lines terminated on station.

b. Data Flow Test Script Mode 1 Operations

(1) Critical RTC Review (See figure 3-3)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 982.

(d) Press INITIATE PBI and monitor the HSP.

(e) Press INITIATE PBI and monitor the HSP.

(2) Computer Fault and Recovery (See figure 3-4)

(a) Load the DARTS paper tape on the I/O reader.

(b) Set STOP 7 up. After 7-STOP, set STOP 7 down.

(c) Press MASTER CLEAR.

(d) Press RUN PBI and start the computer.

(e) Monitor the HSP for the recovery parameter listing.

(3) Select Mode 1 (See figure 3-5)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 979.

(d) Press INITIATE PBI and monitor the HSP.

(e) Press INITIATE PBI and monitor the HSP.

(4) Uplink Real-time Command (See figure 3-6)

(a) Press CLEAR PBI.

(b) Press COMDEC 1 PBI.

(c) CAM 002.

(d) Press INITIATE PBI and monitor the HSP.

(e) Press UPLINK PBI.

(f) Press INITIATE PBI and monitor the CAGE/UDB.

(5) <u>Abort Real-time Command</u> (See figure 3-7)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) Press COMDEC 2 PBI.

(d) CAM 036.

(e) Press INITIATE PBI and monitor the HSP.

(f) Clear all latches.

(g) Press CLEAR PBI.

(h) CAM 976.

(i) Press INITIATE PBI and verify HSP abort printout.

(6) <u>Echo Check Override On</u> (See figure 3-8)

(a) Disable the CAGE unit.

(b) Press CLEAR PBI.

(c) CAM 983.

(d) Press INITIATE PBI.

(e) Press INITIATE PBI and monitor the HSP.

(7) <u>Uplink Real-time Command With Override On</u> (See figure 3-9)

(a) Press CLEAR PBI.

(b) Press COMDEC 1 PBI.

(c) CAM 133.

(d) Press INITIATE PBI.

(e) Press UPLINK PBI.

(f) Press INITIATE PBI and monitor the HSP.

(8) <u>Echo Check Override Off</u> (See figure 3-10)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 984.

(d) Press INITIATE PBI.

(e) Press INITIATE PBI and monitor the HSP.

(9) Uplink Command With CAGE Disabled and Override Off (See figure 3-11)

(a) Press CLEAR PBI.

(b) Press COMDEC 2 PBI.

(c) CAM 137.

(d) Press INITIATE PBI.

(e) Press UPLINK PBI.

(f) Press INITIATE PBI and monitor the HSP for a bad ground loop (echo check).

(10) Uplink Command With CAGE Unit On (See figure 3-12)

(a) Enable the CAGE unit.

(b) Clear all latches.

(c) Press CLEAR PBI.

(d) Press COMDEC 2 PBI.

(e) CAM 027.

(f) Press INITIATE PBI.

(g) Press UPLINK PBI.

(h) Press INITIATE PBI and verify a good command uplinked.

c. Mode 2 CMD and TLM Operations

Note

Mode 2 script must be coordinated with OCC for test performance.

OCC Operations	NTE Operations
(1) Configure for simultaneous R/T and dump data from the ERTS confidence tape (ECT) recorder, via the SCO's to the ERTS ETC and for simultaneous R/T and dump data input from the ERTS ETC.	(1) Configure the tape recorder and mount the CMD analog tape (CMT) to play back CMD data into the computer DTU. Configure to input test data to the RF TLM equipment as shown in figure 3-1.
(2) Mount the ECT on the recorder, and patch the pen recorder per setup instructions. Configure the sigma 3 A and B for hard wire input of ETC ERTS R/T and dump data to computers and pen recorders.	(2) OPSR: Select mode 2: (a) Clear all latches. (b) Press CLEAR PBI. (c) CAM 980.

OCC Operations	NTE Operations
	(d) Press INITIATE PBI.
	(e) Press INITIATE PBI.
(3) Start ECT playback and start the pen recorders.	(3) Start the CMT playback into the 642B.
(4) Verify R/T and dump decom lock.	(4) Verify data through the RF TLM equipment.
(5) Monitor for good TLM data at the decoms and pen recorders.	(5) OPSR and CMPTR: Monitor for good uplink activity.
(6) Stop the ECT data after 10 minutes into the tape.	(6) Stop the CMT after the fourth CMD (OCC uplink 44 49 N).
(7) Terminate SC data to ETC and configure for mission support.	(7) Reconfigure the tape recorder and TLM equipment for mission support.
(8) Provide post-test critique.	(8) Provide post-test critique.

d. Data Flow Summary Operations

(1) Select Mode 1 (See figure 3-15)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 979.

(d) Press INITIATE PBI.

(e) Press INITIATE PBI and monitor the HSP.

(2) Uplink Summary Initiation (See figure 3-16)

(a) Press CLEAR PBI.

(b) CAM 991.

(c) Press INITIATE PBI.

(d) Press INITIATE PBI and monitor the HSP.

(3) <u>End-of-file Initiation</u> (See figure 3-17)

(a) Press CLEAR PBI.

(b) CAM 996.

(c) Press INITIATE PBI.

(d) Press INITIATE PBI and monitor the HSP.

(4) <u>OCC Command History Initiation</u> (See figure 3-18)

(a) Press CLEAR PBI.

(b) CAM 994.

(c) Press INITIATE PBI.

(d) Press INITIATE PBI.

(5) <u>Reinitialization.</u> CMPTR: reinitialize the computer in Phase II with the proper spacecraft revolution number.

(6) <u>Configuration Verification.</u> OPSR and CMPTR: verify that the computer is configured so that type-ins and other variable parameters reflect required support configurations.

(a) All station personnel: ensure that no extraneous or non-mission patch-cords are inserted into jack panels.

(b) OPSR: verify that all equipment is configured to support the mission/pass.

```
CMD ERTS

GMT 00:00:00:00:00:00  PARAMETER LISTING

    STA - ETC   REV - 00000X    GMT YEAR - 72    INIT PHASE - 1

    CMP - TLM     CAM - TLM     MTU - 06

    DTU - X   OUTPUT - 1X   INPUT - 1X

    VEH - A

    MODE - 2 ECHO CHECK OVRD - OFF   UPLINK MODE - ENABLED

    HSD OUTPUT - ENABLED    DESTINATION - OCC

    MINOR FRAME   LOCK -      LOST -      BIT SLIP INDICATOR -


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  TP GMT TAGS ARE ZERO


CMD ERTS
GMT XX:XX:XX:XX:XX:XX  GMT TAGS UPDATED FROM EXTERNAL SOURCE


CMD ERTS
GMT XX:XX:XX:XX:XX:XX  TP GMT TAGS UPDATED FROM EXTERNAL SOURCE
                       XX:XX:XX:XX:XX
```

Figure 3-2. CMD Parameter Listing Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX   CRITICAL RTC REVIEW REQ


CMD ERTS

GMT XX:XX:XX:XX:XX:XX   CRITICAL RTC REVIEW

      CRITICAL          0001 0003 0005 0007 0017 0020 0021 0023
                        0025 0040

                        0042 0044 0045 0046 0061 0063 0100 0102
                        0103 0104

                        0106 0121 0122 0123 0124 0125 0140 0144
                        0145 0161

                        0162 0165 0166 0167 0200 0202 0203 0204
                        0221 0222

                        0223 0225 0246 0247 0251 0264 0265 0266
                        0267 0270

                        0304 0305 0306 0307 0310 0325 0326 0327
                        0331 0344

                        0346 0367 0370 0404 0410 0436 0442 0455
                        0456 0503

                        0540 0560 0600 0613 0615 0622 0627 0633
                        0636 0640

                        0642 0653 0654 0657 0661 0663 0667 0670
                        0673 0674

                        0675 0677 0700 0710 0711 0713 0720 0725
                        0732 0733

                        0734 0746 0752 0753 0754 0767 0776

SUPER-CRITICAL          0142 0352 0507 0574

CIU                     0780 0781 0782 0783 0784 0785 0786 0787
```

Figure 3-3. Critical RTC Review Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  PARAMETER LISTING

    STA - XXX  REV - 000001  GMT YEAR - 7X  INIT PHASE - 2 W-R

    CMP - CMD  CAM - CMD  MTU - 11

    DTU - A  OUTPUT - 12  INPUT - 12

    VEH - A

    MODE - 2  ECHO CHECK OVRD - OFF  UPLINK MODE - ENABLED

    HSD OUTPUT - ENABLED  DESTINATION - OCC

    MINOR FRAME LOCK - 0  LOST - 0  BIT SLIP INDICATOR - 0
```

Figure 3-4. Computer Fault and Recovery Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  MODE 1 REQ

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  MODE 1
```

Figure 3-5. Select Mode 1 Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX   CAM RTC   COMDEN 1 UPLINK REQUEST -
                                  026 6 06 002

    0010110 110 00110 000000001 0  1101001 001 11001 111111101 1


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM UPLINK 0002 03 N


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 00125


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-6. Uplink Real-time Command Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM RTC  COMDEC 1 UPLINK REQUEST -
                                026 6 06 036

    0010110 110 00110 000011110 0  1101001 001 11001 111100001 1

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  LOCAL ABORT

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK ABORTED

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-7. Abort Real-time Command Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  ECHO CHECK OVERRIDE ON REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  ECHO CHECK OVERRIDE ON
```

Figure 3-8. Echo Check Override On Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM RTC  COMDEC 1 UPLINK REQUEST -
                                026 6 06 133

   0010110 110 00110 001011011 0  1101001 001 11001 110100100 1

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM UPLINK 0137 03 0

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 00125

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-9. Uplink Real-time Command With Override On Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  ECHO CHECK OVERRIDE OFF REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  ECHO CHECK OVERRIDE OFF
```

Figure 3-10. Echo Check Override Off Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM RTC  COMDEC 1 UPLINK REQUEST -
                                026 6 05 137

    0010110 110 00110 001011111 0  1101001 001 11001 110100000 1

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM UPLINK 0137 03 N

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 00125 BAD

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-11. Uplink Command With CAGE Disabled and Override Off Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM TRC  COMDEC 1 UPLINK REQUEST -
                                026 6 06 027

    0010110 110 00110 000010111 0  1101001 001 11001 111101000 1

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM UPLINK 0027 03 N

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 00125

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-12. Uplink Command With CAGE Unit On Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  MODE 2 REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CMD MODE 2
```

Figure 3-13. Mode 2 Selection Printout (OCC)

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  PARAMETER LISTING REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  PARAMETER LISTING

    STA - ETC  REV - 000000  GMT YEAR - 72   INIT PHASE - 2W-R

    CMP - CMD  CAM - CMD  MTU - 11

    DTU - A  OUTPUT - 12  INPUT - 12

    VEH - A

    MODE - 2  ECHO CHECK OVRD - OFF  UPLINK MODE - ENABLED

    HSD OUTPUT - ENABLED  DESTINATION - OCC

    MINOR FRAME LOCK - 0  LOST - 0  BIT SLIP INDICATOR - 0

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  GMT TAGS UPDATED FROM EXTERNAL SOURCE
```

Figure 3-14. Parameter Listing Request Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  MODE 1 REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  MODE 1
```

Figure 3-15. Select Mode 1 Printout

```
CMD ERTS
GMT XX:XX:XX:XX:XX:XX  CMD UPLINK SUMMARY REQ

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  CMD UPLINK SUMMARY
    001  CAM XX:XX:XX  1  0002     00125
    002  CAM XX:XX:XX   1  0036       00000  ABT
    003  CAM XX:XX:XX   2  0133       00125  GOOD
    004  OCC XX:XX:XX  34  XX-XXXX    00625
    005  OCC XX:XX:XX  35  XX-XXXX    00675
    006  OCC XX:XX:XX  41  XX-XXXX    01525
    007  OCC XX:XX:XX  43  XX-XXXX    01625
    008  OCC XX:XX:XX  44  XX-XXXX    02425
```

Figure 3-16. Uplink Summary Initiation Printout

```
CMD ERTS
GMT XX:XX:XX:XX:XX:XX  END-OF-FILE REQ

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  PARAMETER LISTING
    STA - XXX  REV - 0000001  GMT YEAR - 7X  INIT PHASE - 2 W -R
    CMP - CMD  CAM - CMD  MTU - 11
    DTU - C  OUTPUT - 12  INPUT - 10
    VEH - A
    MODE - 2  ECHO CHECK OVRD - OFF  UPLINK MODE - ENABLED
    HSD OUTPUT - ENABLED  DESTINATION - OCC
    MINOR FRAME LOCK - LOST -  BIT SLIP INDICATOR -

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  END-OF-FILE
```

Figure 3-17. End-of-file Initiation Printout

To be supplied.

Figure 3-18. OCC Command History Initiation Printout

3.1.2 ULA, EGD, AND BACKUP USB STATIONS ON-SITE DATA FLOW TEST

OBJECTIVE

The objective of this test is to make an end-to-end check, verifying that the station is correctly patched and capable of meeting mission requirements. This will be a final check of hardware and software prior to network testing.

TEST DESCRIPTION

The test objective will be accomplished by flowing uplink data from the DTU/modem through the system to the antenna, while injecting simulated downlink data into the paramp, and then flowing this data through the system to the output modem.

3.1.2.1 Test Setup

a. Configure the equipment as shown in figure 3-19 or 3-19A.

b. The Command Analog Tape supplied to the station will be used to simulate OCC-generated commands. The Magnetic Tape Recorder (MTR) clock and data tracks will be patched to the dc side of the station receive modems.

c. Set up the PCM simulator to simulate dump and then real-time data, and adjust the output to modulate the 597 kHz and 768 kHz SCO ±90 degrees.

d. Set the test transmitter for -112 dBm (-110 dBm at ULA) into the parametric amplifier as measured on the receiver AGC.

e. Set up the individual subcarriers to phase modulate the test transmitter as follows:

Subcarrier		Carrier Suppression
Real-time	768 kHz	0.2 dB
Dump	597 kHz	1.5 dB
DCS	1.024 MHz	2.3 dB

f. Record parameters specified by the NOSP, STDN No. 601/ERTS, on strip-chart and event recorders.

3.1.2.2 Test Procedures

a. CMD and TLM

(1) Load the ERTS operational program as given in SCAN 6-863.

(2) Patch SRT CMD and CLK tracks to the dc side of the receive modem.

Note

The Command Analog Tape requires the computer be initialized with ETC as a site ID.

C-4

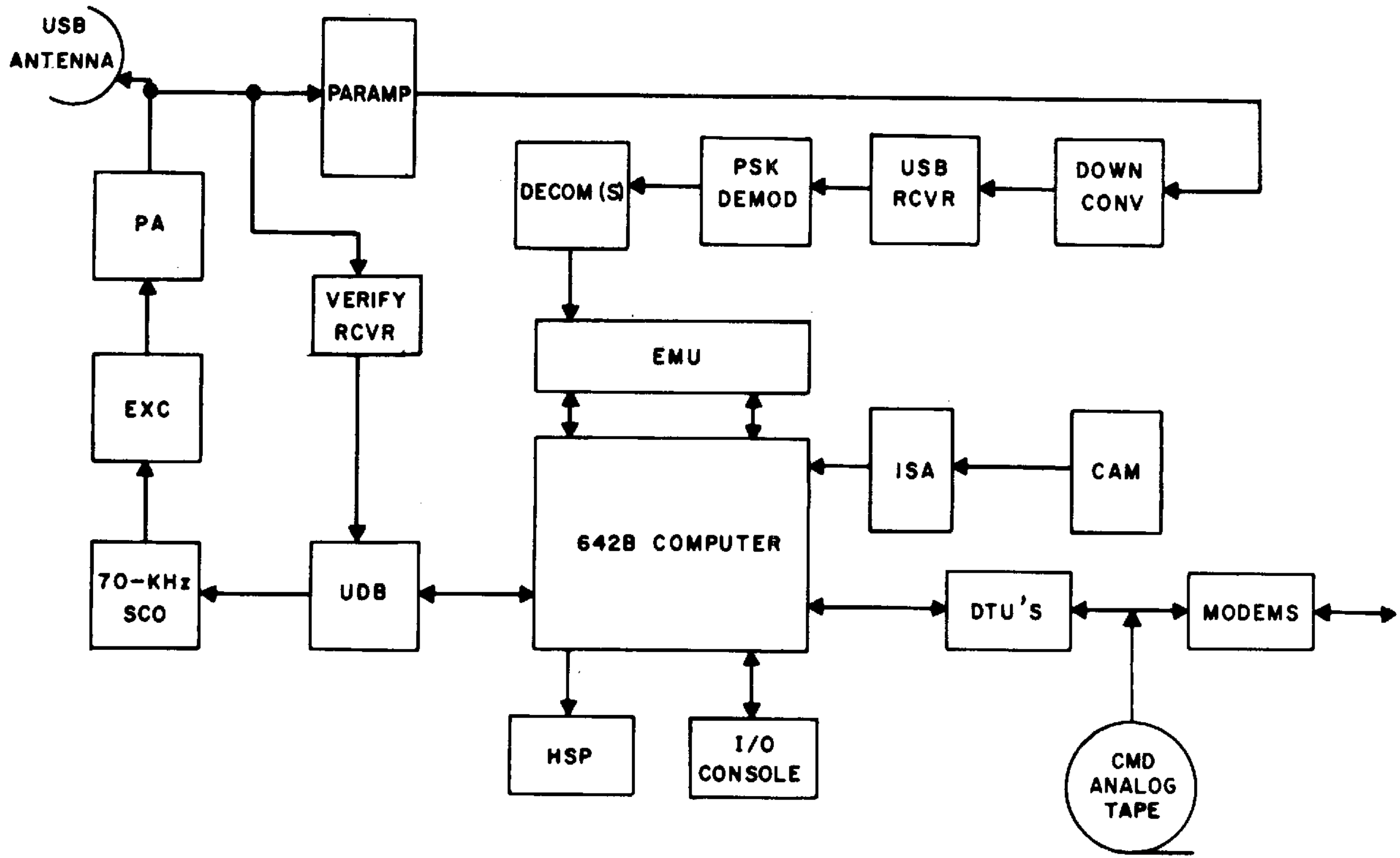


Figure 3-19. EGD and Backup USB Station Typical Configuration

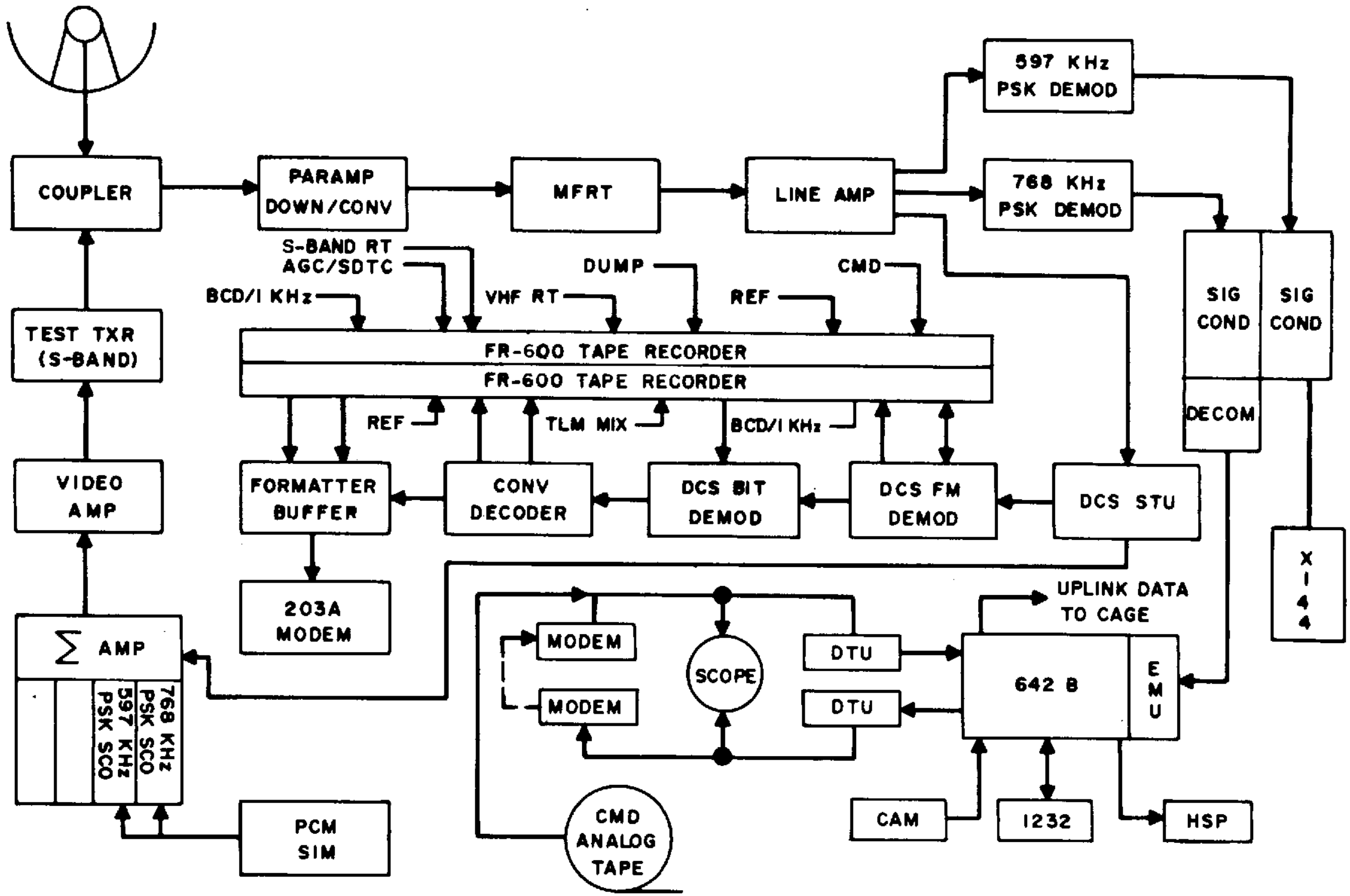


Figure 3-19A. ULA Typical Test Configuration

(3) Verify that all required MTU's are loaded as specified in STDN No. 601/ERTS.

(4) Bring up CMD carrier and radiate into the antenna or dummy load, depending on radiation clearance.

(5) Recorder: record 24-kb/sec data on the dump data track specified in STDN No. 601/ERTS.

(6) PCM: play the simulator into the test injection network at 24 kb/sec.

(7) TLM: verify that 24-kb/sec data modulates the 597-kHz SCO.

(8) RCDR: Record 5 minutes of PCM simulator dump data (FMT 2). Prepare to play back the tape into the decom at the rate specified in STDN No. 601/ERTS. Advise PCM when ready to play the tape.

Note

> Do not rewind the tape, as the dump data must be played back with the recorder in the reverse playback mode.

(9) OPSR should verify the following (see figure 3-20):

(a) RF CMD system is operational.

(b) Computer is cycling and uplink mode is enabled.

(c) All PCM inhibits to the computer are on.

(d) GCC has all high- and low-speed data lines terminated on station.

b. Data Flow Test Script Mode 1 Operations

(1) Critical RTC Review (See figure 3-21)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 982.

(d) Press INITIATE PBI and monitor the HSP.

(e) Press INITIATE PBI and monitor the HSP.

(2) Computer Fault and Recovery (See figure 3-22)

(a) Load the DARTS paper tape on the I/O reader.

(b) Set STOP 7 up. After 7-STOP, set STOP 7 down.

(c) Press MASTER CLEAR.

(d) Press RUN PBI and start the computer.

(e) Monitor the HSP for the recovery parameter listing.

(3) Select Mode 1 (See figure 3-23)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 979.

(d) Press INITIATE PBI and monitor the HSP.

(e) Press INITIATE PBI and monitor the HSP.

(4) Dump Telemetry Playback. (See figure 3-24.) PCM: advise RCDR to start playback of the dump TLM track into the decom, at the rate specified in the NOSP. Set playback switch to ON, and remove inhibit to the computer.

(5) Uplink Real-time Command (See figure 3-25)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) Press COMDEC 1 PBI.

(d) CAM 002.

(e) Press INITIATE PBI and monitor the HSP.

(f) Press UPLINK PBI.

(g) Press INITIATE PBI and monitor the UDB/CAGE.

(6) Abort Real-time Command (See figure 3-26)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) Press COMDEC 2 PBI.

(d) CAM 036.

(e) Press INITIATE PBI and monitor the HSP.

(f) Clear all latches.

(g) Press CLEAR PBI.

(h) CAM 976.

(i) Press INITIATE PBI and verify HSP abort printout.

(7) Echo Check On (See figure 3-27)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 983.

(d) Press INITIATE PBI.

(e) Press INITIATE PBI.

(8) Uplink Command With CAGE/UDB Disabled and Override On (See figure 3-28).

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) Press COMDEC 1 PBI.

(d) CAM 137.

(e) Press INITIATE PBI and monitor the HSP.

(f) Press UPLINK PBI.

(g) Press INITIATE PBI and monitor the HSP for a bad ground loop (echo check).

(9) Echo Check Off (See figure 3-29)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 984.

(d) Press INITIATE PBI.

(e) Press INITIATE PBI.

(10) Uplink Command With CAGE/UDB Unit On (See figure 3-30)

(a) Enable the CAGE unit.

(b) Clear all latches.

(c) Press CLEAR PBI.

(d) Press COMDEC 2 PBI.

(e) CAM 027.

(f) Press INITIATE PBI.

(g) Press INITIATE PBI and verify a good command uplinked.

c. Data Flow Test Script Mode 2 Operations

(1) Select Mode 2 (See figure 3-31)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 980.

(d) Press INITIATE PBI.

(e) Press INITIATE PBI.

(2) Parameter Listing (See figure 3-32)

(a) Press CLEAR PBI.

(b) CAM 990.

(c) Press INITIATE PBI.

(d) Press INITIATE PBI and monitor the HSP output.

(e) Stop the dump telemetry playback, remove the PLAYBACK bit.

(3) Simulated HSD Inputs From OCC and Real-time TLM Flow (See figure 3-33)

(a) RDCR: start the Command Analog Tape.

(b) OPSR and CMPTR: monitor the HSP printouts for errors.

(c) PCM: start the simulator and output 1-kb/sec data into the test injection network.

(d) GCC: verify a one-to-one data indication on the oscilloscope while in the oscilloscope "chop mode" (refer to figure 3-19A for oscilloscope configuration).

(e) Stop the tape and simulator after HSP printout of the fourth command (OCC UPLINK 44 49 N).

d. Data Flow Summary Operations

(1) Select Mode 1 (See figure 3-34)

(a) Clear all latches.

(b) Press CLEAR PBI.

(c) CAM 979.

(d) Press INITIATE PBI.

(e) Press INITIATE PBI and monitor the HSP.

(2) Uplink Summary Initiation (See figure 3-35)

(a) Press CLEAR PBI.

(b) CAM 991.

(c) Press INITIATE PBI.

(d) Press INITIATE PBI and monitor the HSP.

(3) End-of-file Initiation (See figure 3-36)

(a) Press CLEAR PBI.

(b) CAM 996.

(c) Press INITIATE PBI.

(d) Press INITIATE PBI and monitor the parameter listing.

(4) Local Command History Initiation (See figure 3-37)

(a) Press CLEAR PBI.

(b) CAM 992.

(c) Press INITIATE PBI.

(d) Press INITIATE PBI and monitor the HSP.

(5) OCC Command History Initiation (See figure 3-38)

(a) Press CLEAR PBI.

(b) CAM 994.

(c) Press INITIATE PBI and monitor the HSP.

(d) Press INITIATE PBI and monitor the TTY.

(6) OPSR: verify that all equipment is configured to support the mission/pass.

(7) CMPTR: reinitialize the computer in phase II with the proper spacecraft revolution number.

(8) All station personnel: ensure that no extraneous or nonmission patch-cords are inserted into jack panels.

(9) OPSR and CMPTR: verify that the computer is configured so that type-ins and other variable parameters reflect required support configurations.

```
CMD ERTS

GMT 00:00:00:00:00:00  PARAMETER LISTING

    STA - ETC   REV - 00000X    GMT YEAR - 72    INIT PHASE - 1

    CMP - TLM     CAM - TLM     MTU - 06

    DTU - X   OUTPUT - 1X   INPUT - 1X

    VEH - A

    MODE - 2 ECHO CHECK OVRD - OFF   UPLINK MODE - ENABLED

    HSD OUTPUT - ENABLED    DESTINATION - OCC

    MINOR FRAME   LOCK - 0    LOST - 0    BIT SLIP INDICATOR -D


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  TP GMT TAGS ARE ZERO


CMD ERTS
GMT XX:XX:XX:XX:XX:XX  GMT TAGS UPDATED FROM EXTERNAL SOURCE


CMD ERTS
GMT XX:XX:XX:XX:XX:XX  TP GMT TAGS UPDATED FROM EXTERNAL SOURCE
                       XX:XX:XX:XX:XX
```

Figure 3-20. Parameter Listing Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX   CRITICAL RTC REVIEW REQ


CMD ERTS

GMT XX:XX:XX:XX:XX:XX   CRITICAL RTC REVIEW

      CRITICAL          0001 0003 0005 0007 0017 0020 0021 0023
                        0025 0040

                        0042 0044 0045 0046 0061 0063 0100 0102
                        0103 0104

                        0106 0121 0122 0123 0124 0125 0140 0144
                        0145 0161

                        0162 0165 0166 0167 0200 0202 0203 0204
                        0221 0222

                        0223 0225 0246 0247 0251 0264 0265 0266
                        0267 0270

                        0304 0305 0306 0307 0310 0325 0326 0327
                        0331 0344

                        0346 0367 0370 0404 0410 0436 0442 0455
                        0456 0503

                        0540 0560 0600 0613 0615 0622 0627 0633
                        0636 0640

                        0642 0653 0654 0657 0661 0663 0667 0670
                        0673 0674

                        0675 0677 0700 0710 0711 0713 0720 0725
                        0732 0733

                        0734 0746 0752 0753 0754 0767 0776

SUPER-CRITICAL          0142 0352 0507 0574

CIU                     0780 0781 0782 0783 0784 0785 0786 0787
```

Figure 3-21. Critical RTC Review Printout

```
CMD ERTS
GMT XX:XX:XX:XX:XX:XX  PARAMETER LISTING
    STA - XXX  REV - 000001  GMT YEAR - 7X  INIT PHASE - 2 W-R
    CMP - CMD  CAM - CMD  MTU - 11
    DTU - A  OUTPUT - 12  INPUT - 12
    VEH - A
    MODE - 2  ECHO CHECK OVRD - OFF  UPLINK MODE - ENABLED
    HSD OUTPUT - ENABLED  DESTINATION - OCC
    MINOR FRAME LOCK - 0  LOST - 0  BIT SLIP INDICATOR - 0
```

Figure 3-22. Computer Fault and Recovery Printout

```
CMD ERTS
GMT XX:XX:XX:XX:XX:XX  MODE 1 REQ

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  MODE 1
```

Figure 3-23. Select Mode 1 Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  PCM SYNC LOST CH 1

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  PCM CH 1 MFIO LOST

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  PCM CH 1 MFIO LOCK

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-24. Dump Telemetry Playback Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM RTC  COMDEN 1 UPLINK REQUEST -
                                026 6 06 002

   0010110 110 00110 000000001 0  1101001 001 11001 111111101 1

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM UPLINK 0002 03 N

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 00125

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-25. Uplink Real-time Command Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM RTC  COMDEC 1 UPLINK REQUEST -
                                026 6 06 036

    0010110 110 00110 000011110 0  1101001 001 11001 111100001 1

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  LOCAL ABORT

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK ABORTED

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-26. Abort Real-time Command Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  ECHO CHECK OVERRIDE ON REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  ECHO CHECK OVERRIDE ON
```

Figure 3-27. Echo Check On Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM RTC  COMDEC 1 UPLINK REQUEST -
                                026 6 06 137

    0010110 110 00110 001011111 0  1101001 001 11001 110100000 1


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM UPLINK 0137 03 0


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 00125 BAD


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-28. Uplink Command with CAGE/UDB Disabled and Override On Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  ECHO CHECK OVERRIDE OFF REQ


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  ECHO CHECK OVERRIDE OFF
```

Figure 3-29. Echo Check Off Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM TRC  COMDEC 1 UPLINK REQUEST -
                                026 6 06 027

    0010110 110 00110 000010111 0  1101001 001 11001 111101000 1

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CAM UPLINK 0027 03 N

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 00125

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-30. Uplink Command With CAGE/UDB Unit On Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CMD MODE 2 REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CMD MODE 2
```

Figure 3-31. Select Mode 2 Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  PARAMETER LISTING REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  PARAMETER LISTING

    STA - ETC  REV - 000000  GMT YEAR - 72   INIT PHASE - 2W-R

    CMP - CMD  CAM - CMD  MTU - 11

    DTU - A  OUTPUT - 12  INPUT - 12

    VEH - A

    MODE - 2  ECHO CHECK OVRD - OFF  UPLINK MODE - ENABLED

    HSD OUTPUT - ENABLED  DESTINATION - OCC

    MINOR FRAME LOCK - 0  LOST - 0  BIT SLIP INDICATOR - 0

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  GMT TAGS UPDATED FROM EXTERNAL SOURCE
```

Figure 3-32. Parameter Listing Printout

```
CMD ERTS
GMT XX:XX:XX:XX:XX:XX  OCC UPLINK 34 13 N

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 00625

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  OCC UPLINK 35 14 N

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 00675

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA ON
```

Figure 3-33. Simulated HSD Inputs from OCC and Real-time TLM Flow Printout

```
CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  OCC UPLINK 41 31 N

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 01525

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  OCC UPLINK 43 33 N

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS
GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 01625
```

Figure 3-33. Simulated HSD Inputs from OCC and Real-time TLM Flow Printout (cont)

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF


CMD ERTS

GMT XX:XX:XX:XX:XX:XX  OCC UPLINK 44 49 N

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  UPLINK COMPLETED 02425

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA ON

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  HSD DATA OFF
```

Figure 3-33. Simulated HSD Inputs from OCC and Real-time TLM Flow Printout (cont)

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  MODE 1 REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  MODE 1
```

Figure 3-34. Select Mode 1 Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CMD UPLINK SUMMARY REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  CMD UPLINK SUMMARY
    001  CAM XX:XX:XX  1  0002     00125

    002  CAM XX:XX:XX   1  0036       00000  ABT
    003  CAM XX:XX:XX   2  0133       00125  GOOD
    004  OCC XX:XX:XX  34  XX-XXXX    00625
    005  OCC XX:XX:XX  35  XX-XXXX    00675
    006  OCC XX:XX:XX  41  XX-XXXX    01525
    007  OCC XX:XX:XX  43  XX-XXXX    01625
    008  OCC XX:XX:XX  44  XX-XXXX    02425
```

Figure 3-35. Uplink Summary Initiation Printout

```
CMD ERTS

GMT XX:XX:XX:XX:XX:XX  END-OF-FILE REQ

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  PARAMETER LISTING

    STA - XXX  REV - 0000001  GMT YEAR - 7X  INIT PHASE - 2 W -R

    CMP - CMD  CAM - CMD  MTU - 11

    DTU - C  OUTPUT - 12  INPUT - 10

    VEH - A

    MODE - 2  ECHO CHECK OVRD - OFF  UPLINK MODE - ENABLED

    HSD OUTPUT - ENABLED  DESTINATION - OCC

    MINOR FRAME LOCK - LOST -  BIT SLIP INDICATOR -

CMD ERTS

GMT XX:XX:XX:XX:XX:XX  END-OF-FILE
```

Figure 3-37. End-of-file Initiation Printout

To be supplied

Figure 3-38. Local Command History Initiation Printout

To be supplied

Figure 3-39. OCC Command History Initiation Printout

3.2 DUMP DATA FLOW TEST (ALASKA ONLY)

OBJECTIVE

The objective of this test is to perform a brief end-to-end station check using the S-band and VHF simulated ERTS dump PCM data, verifying the station's ability to support these particular ERTS mission requirements.

TEST DESCRIPTION

The test objective is accomplished by injecting a simulated ERTS PCM signal into the S-band and VHF links, at a nominal signal level, and observing that the DHE, tape recorders, and DTS system performance are nominal.

3.2.1 S-BAND DUMP DATA (2287.5 MHz Link)

3.2.1.1 Point the 85-foot antenna to a known quiet location in the sky.

3.2.1.2 Configure the station as shown in figure 3-40.

3.2.1.3 Set the operating controls of all the referenced equipment in accordance with the parameters defined in the STDN 601/ERTS.

3.2.1.4 Terminate the X144 data terminal on station.

3.2.1.5 Start the ERTS dump data formatted PCM simulator.

3.2.1.6 Using the unmodulated PSK source, modulate the RF signal generator for a modulation index of 0.81 radian. (Refer to Appendix D for modulation setup procedure.)

3.2.1.7 Set the output of the signal generator for an input level of -110 dBm at the preamplifier input. Apply PCM modulation.

3.2.1.8 Verify that the receiver video signal measures 2 Vpp (±0.2 Vpp) at the input to the tape recorder.

3.2.1.9 Set the recorder tape speed to 15 in./sec and record a short interval of PCM data.

3.2.1.10 Using the tape eval verify the quality of the recorded data.

3.2.1.11 Verify bit and group synchronization and verify that selected data is properly displayed.

3.2.1.12 Verify that the X144 data terminal is receiving the proper signal.

3.2.1.13 Reconfigure the system for operations.

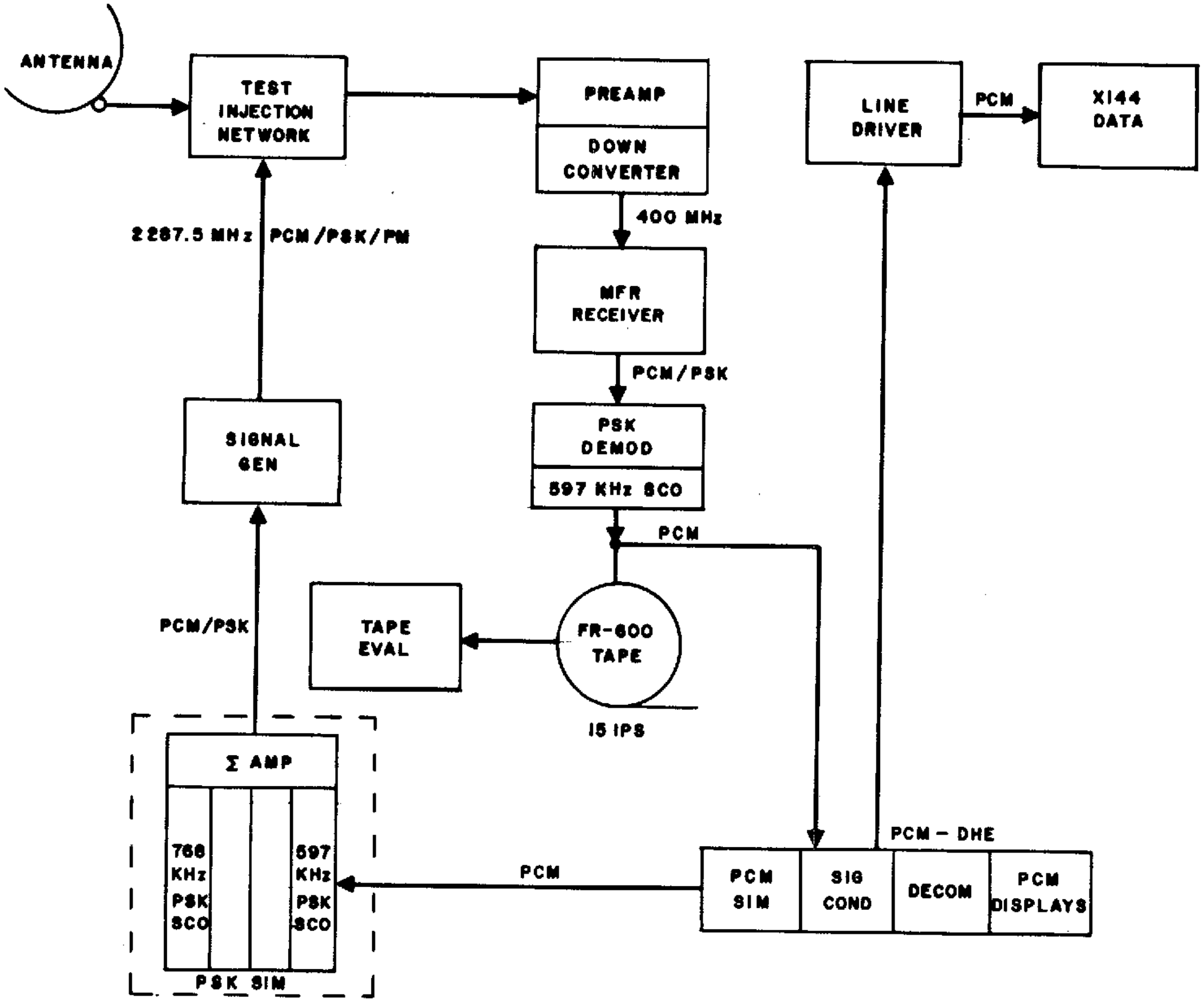


Figure 3-40. S-band On-site Dump Data Flow Test Configuration (ULA)

3.2.2 VHF DUMP DATA TEST (137.86 MHz)

3.2.2.1 Point the 85-foot antenna to a known quiet location in the sky.

3.2.2.2 Configure the station as shown in figure 3-41.

3.2.2.3 Set the operating controls of all the referenced equipment in accordance with the parameters defined in the ERTS NOSP.

3.2.2.4 Terminate the X144 data terminal on station.

3.2.2.5 Start the ERTS Dump Data Format in PCM simulator.

3.2.2.6 Using the PCM simulator, modulate the RF signal generator for a modulation index of 1.14 radians.

3.2.2.7 Set the output of the RF signal generator for an input level of -110 dBm at the preamplifier input.

3.2.2.8 Verify that the receiver video signal measures 2 Vpp (±0.2 Vpp) at the input to the tape recorder.

3.2.2.9 Set the recorder tape speed to 15 in./sec and record a short interval of PCM data.

3.2.2.10 Using the tape eval unit, verify the quality of the recorded data.

3.2.2.11 Verify bit and group synchronization, and verify that selected data is properly displayed.

3.2.2.12 Verify that the X144 data terminal is receiving the proper signal.

3.2.2.13 Reconfigure the system for operations.

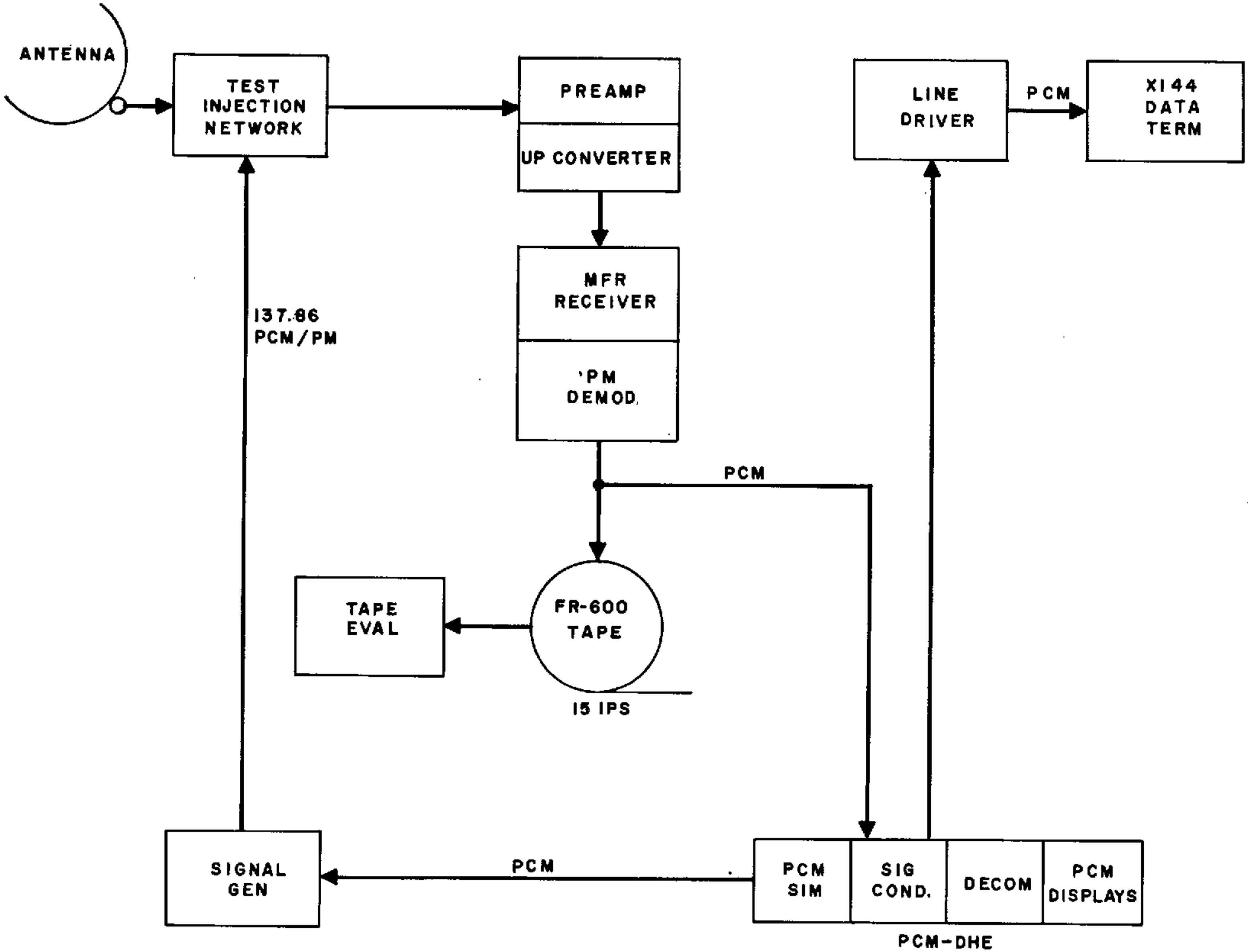


Figure 3-41. VHF Dump Data Test Configuration (ULA)

3.3 DCS DATA FLOW TEST

OBJECTIVE

The objective of this test is to verify the data path and data transfer from the S-band parametric amplifier through the High-speed Data (HSD) modem.

TEST DESCRIPTION

The test objective is accomplished by injecting the simulated mission composite signal into the parametric amplifier and monitoring the data transfer through the ground station equipment in a mission configuration.

PREREQUISITES

The following prerequisites must have been completed before beginning this test:

a. The S-band PM Downlink Test (para 2.6.1) must have been completed prior to the start of this test.

b. The Remote Site Equipment (RSE) should be set up and operating in mission configuration as specified in the Network Operations Support Plan for the Earth Resources Technology Satellite (ERTS), STDN No. 601/ERTS.

3.3.1 TEST APPLICABILITY

This test is applicable to prime ERTS stations only and should be performed concurrent with the Real-time Data Flow Test given in paragraph 3.1.

3.3.2 TEST PROCEDURES

Use the following procedures to perform the DCS Data Flow Test.

DCS Data Flow Test

Seq	Operator	Instructions
1	USB/MFR/ TLM	Configure the equipment as shown in figure 3-42 or 3-43 as applicable. Set up all remote site equipment for mission support as specified in STDN No. 601/ERTS. Set up the DCS equipment as specified in table 3-1.
2	USB/MFR/ TLM	Set up the individual subcarriers to phase modulate the S-band test transmitter as follows: Subcarrier — Mod Index — Carrier Suppression *RT 768 kHz — 0.30 radian — 0.2 dB *DT 597 kHz — 0.81 radian — 1.5 dB DCS 1.024 MHz — 0.99 radian — 2.3 dB
3	TLM	Set up the PCM simulator to simulate either the RT or DT data and adjust the output level to PSK the 768-kHz and 597-kHz SCO's to ±90 degrees.
4	USB/MFR	Set the test transmitter suppressed carrier level for a -112-dBm (-110 dBm at Alaska) into the parametric amplifier as measured on the receiver coherent AGC meter.
5	RCDR	With the magnetic tape recorder loaded with clean scratch tape, verify correct recorder operation by recording and reproducing each of the required DCS signals.
6	DCS	Note If station will be transmitting DCS data to the OCC in real time, perform the following sequences with the output of the convolutional decoder connected directly to the formatter buffer. If the station will be transmitting the DCS data to the OCC post pass, perform the following sequences with data and time recorded in sequence 5 being played back into the DCS equipment.

*Data from OCC

DCS Data Flow Test (cont)

Seq	Operator	Instructions
6 (cont)		Operate the formatter-buffer MASTER CLEAR PBI and verify that the CLEAR TO SEND indicator is ON.
7	DCS	Connect an oscilloscope to monitor the OUTPUT DATA test point on the formatter-buffer and synchronize the oscilloscope with the BLOCK SYNC test point output. Utilizing the oscilloscope delayed sweep, verify the NASCOM block format as shown in figure 3-44. Verify that the source code, destination code, data format, data message, and time-tag bit patterns concur with the original data as selected or indicated at the data source.
8	DCS/COMM	Disconnect the oscilloscope from the formatter-buffer OUTPUT DATA test point and connect the oscilloscope to monitor the dc side of the RX HSD modem. Synchronize the oscilloscope with the BLOCK SYNC test point output from the formatter-buffer. Verify source code, destination code, data format, data message, and time-tag bit patterns as in sequence 7. Note If a test cable is not available between the DCS area and HSD modems, it may be necessary to install same in order to perform sequence 8.

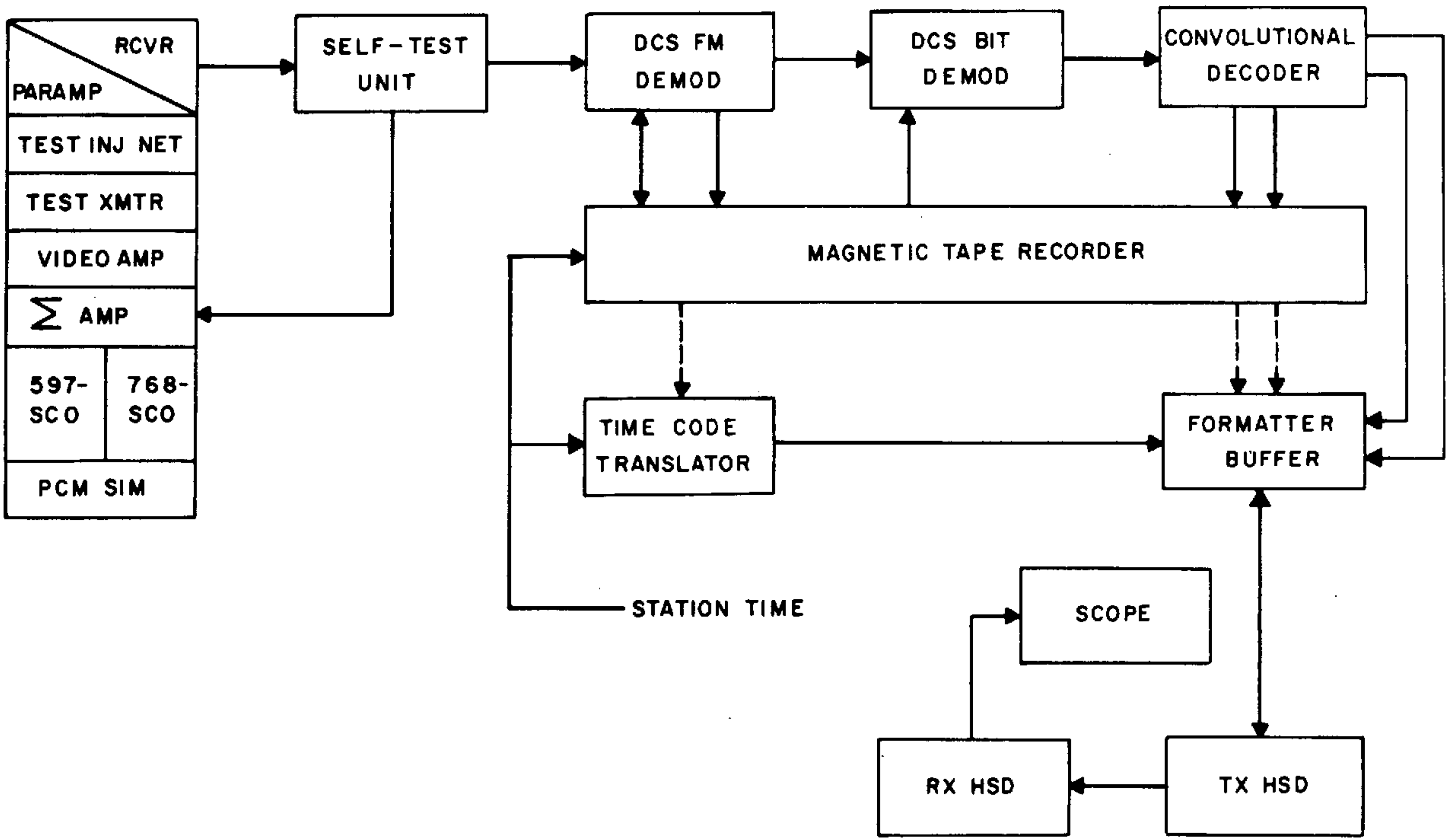


Figure 3-42. DCS Data Flow Test Configuration (GDS and ULA)

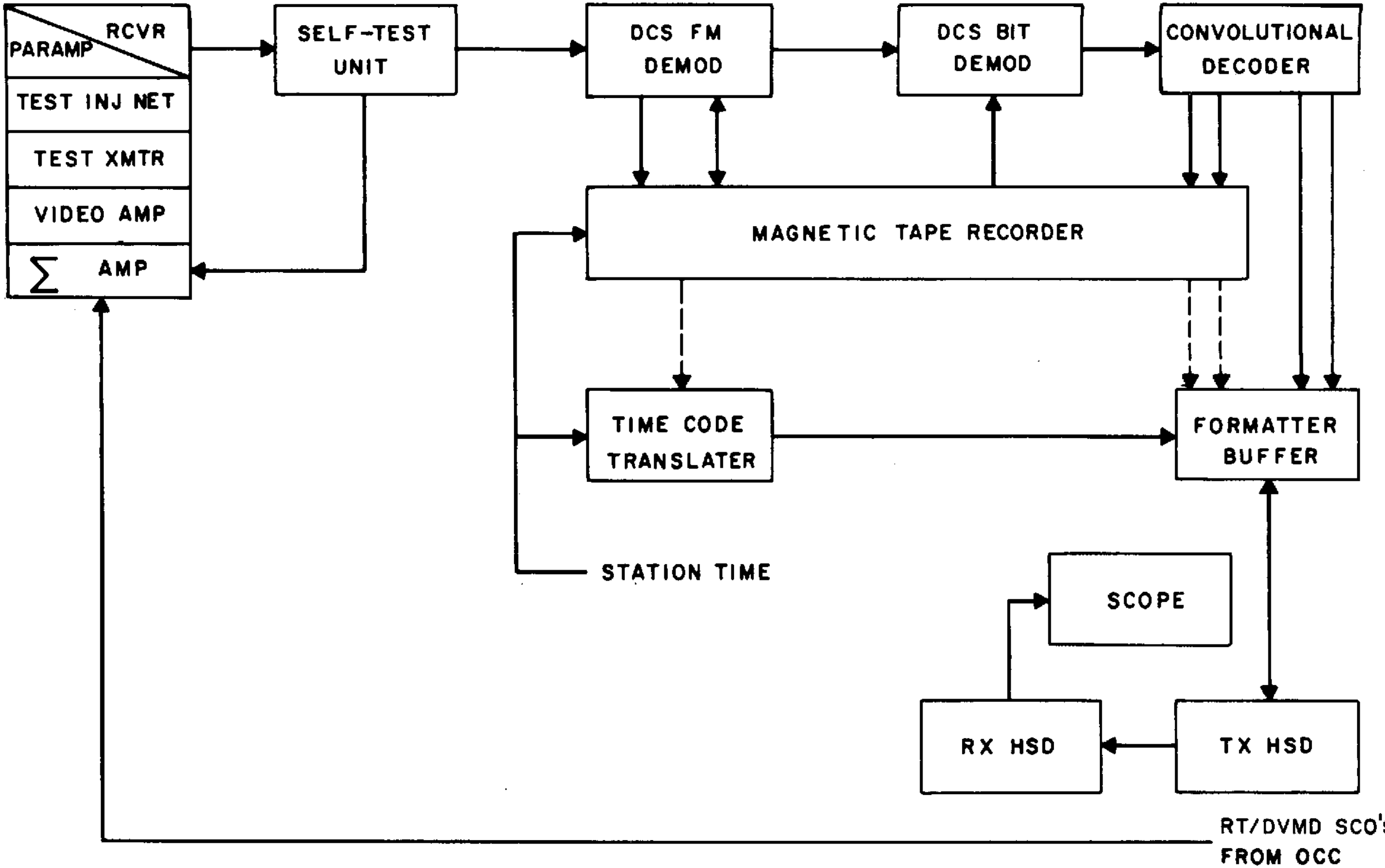


Figure 3-43. DCS Data Flow Test Configuration (ETC)

Table 3-1. DCS Equipment Test Settings

Equipment	Control/Switch	Indication
FM Demod	AUTO-MANUAL	AUTO
	PLAYBACK	OFF
	CHANNEL STATUS	SELECT 1, 2, 3, 4, 5, 6
	INHIBIT	OFF
Bit Demod	INPUT SOURCE	RECEIVER
Conv. Decoder	MODE	OPERATE
	AUTO HALT-FREE RUN	
Self Test Unit	VCO AUTO MAN	AUTO
	VCO ON-OFF	ON
	NOISE ON-OFF	ON
	C/KT ADJUST	+3
	MODE SEL	TEST
	STU-RECEIVER	RECEIVER
	RUN-HOLD	RUN
	MESSAGE SEL	1-0
	TIME DELAY	6 M sec
	DISPLAY	OFF
Formatter Buffer	DATA SOURCE	DECODER
	REQUEST TO SEND	ON
	HEADER SOURCE	
	Alaska	367
	Goldstone	260
	NTTF	130
	DESTINATION CODE	177
	DATA FORMAT	156
	BURST-CONT.	BURST
	MASTER CLEAR	Press to Clear
Time Code Reader	POLARITY	+ (Plus)
	FWD-REV	FWD
	CODE	N3

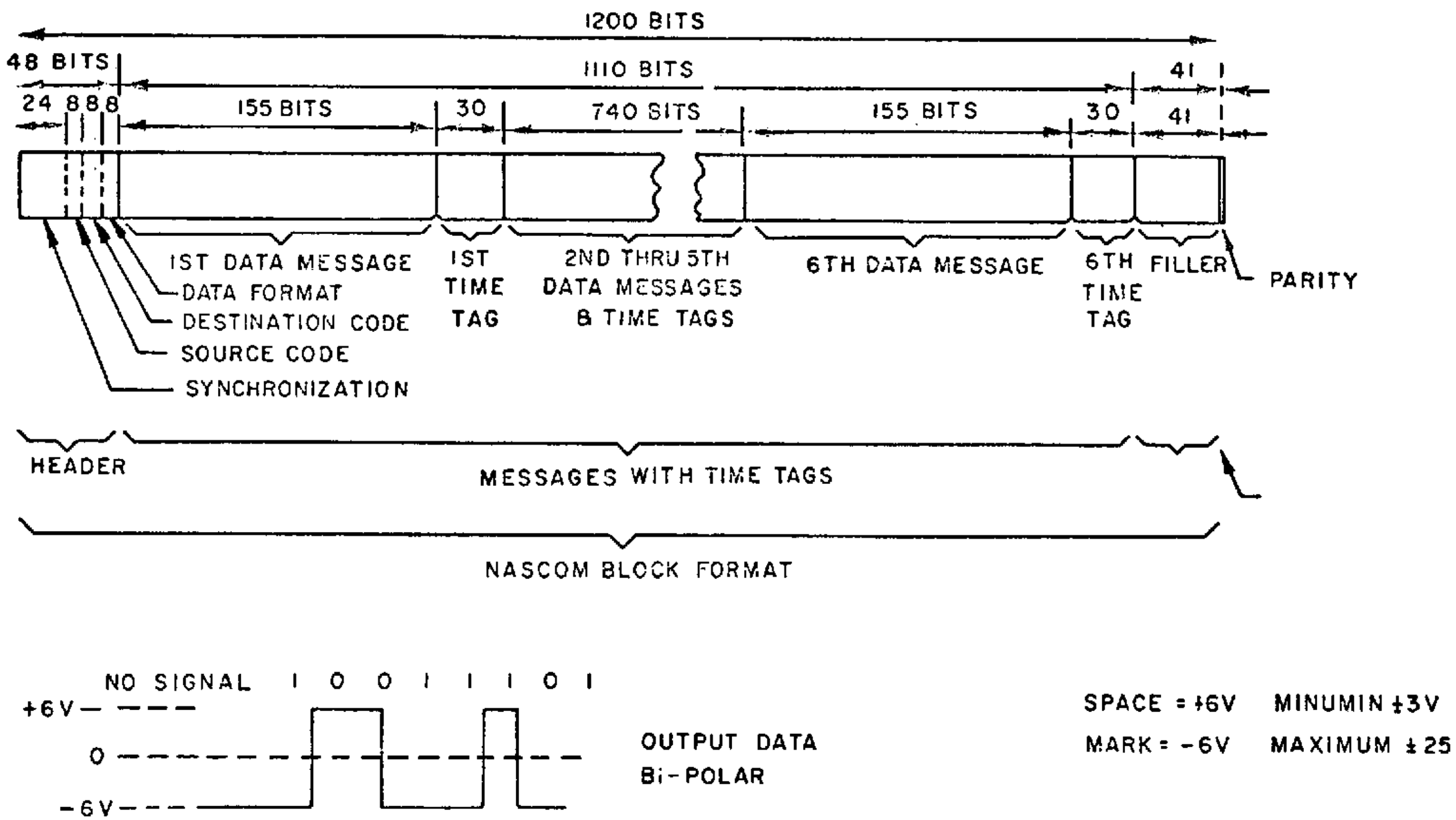


Figure 3-44. Formatter Buffer Output Message Format

3.4 VHF STATION DATA FLOW TEST

OBJECTIVE

The objective of this test is to perform a brief end-to-end station check, using the simulated Earth Resources Technology Satellite (ERTS) real-time and dump PCM data formats, verifying the station's ability to support these particular phases of the ERTS mission.

TEST DESCRIPTION

The test objective is accomplished by injecting a simulated ERTS PCM signal into the RF link, at a nominal signal level, and observing that the DHE, tape recorder, and DTS system's performance are nominal.

3.4.1 REAL-TIME PCM DATA

3.4.1.1 Configure the station equipment as shown in figure 3-45.

3.4.1.2 Set the operating controls of all this referenced equipment in accordance with the parameter defined in the ERTS NOSP.

3.4.1.3 Point the VHF antenna to a known quiet location in the sky.

3.4.1.4 Using the 136-MHz test injection, inject a test signal of 137.86 MHz at an input power level of -110 dBm, at the preamplifier input.

3.4.1.5 Adjust the ERTS 1 kb RT PCM modulation level of the signal generator for a modulation index of 1.14 radians. This corresponds to a reduction in carrier power of 8.2 kB. (Refer to Appendix D, section 2.)

3.4.1.6 Verify that the receiver video signal measures 2Vpp (± 0.2) Vpp at the input to the data magnetic tape recorder.

3.4.1.7 Using the Tape Evaluation Unit, verify the quality of the recorded data.

3.4.1.8 Verify that the PCM data handling equipment is capable of attaining synchronization and that selected data can be displayed properly.

3.4.1.9 Verify proper operation of the DTS.

3.4.2 DUMP PCM DATA

3.4.2.1 Configure the station equipment as shown in figure 3-46A.

3.4.2.2 Set the operating controls of all the referenced equipment in accordance with the parameter defined in the ERTS NOSP.

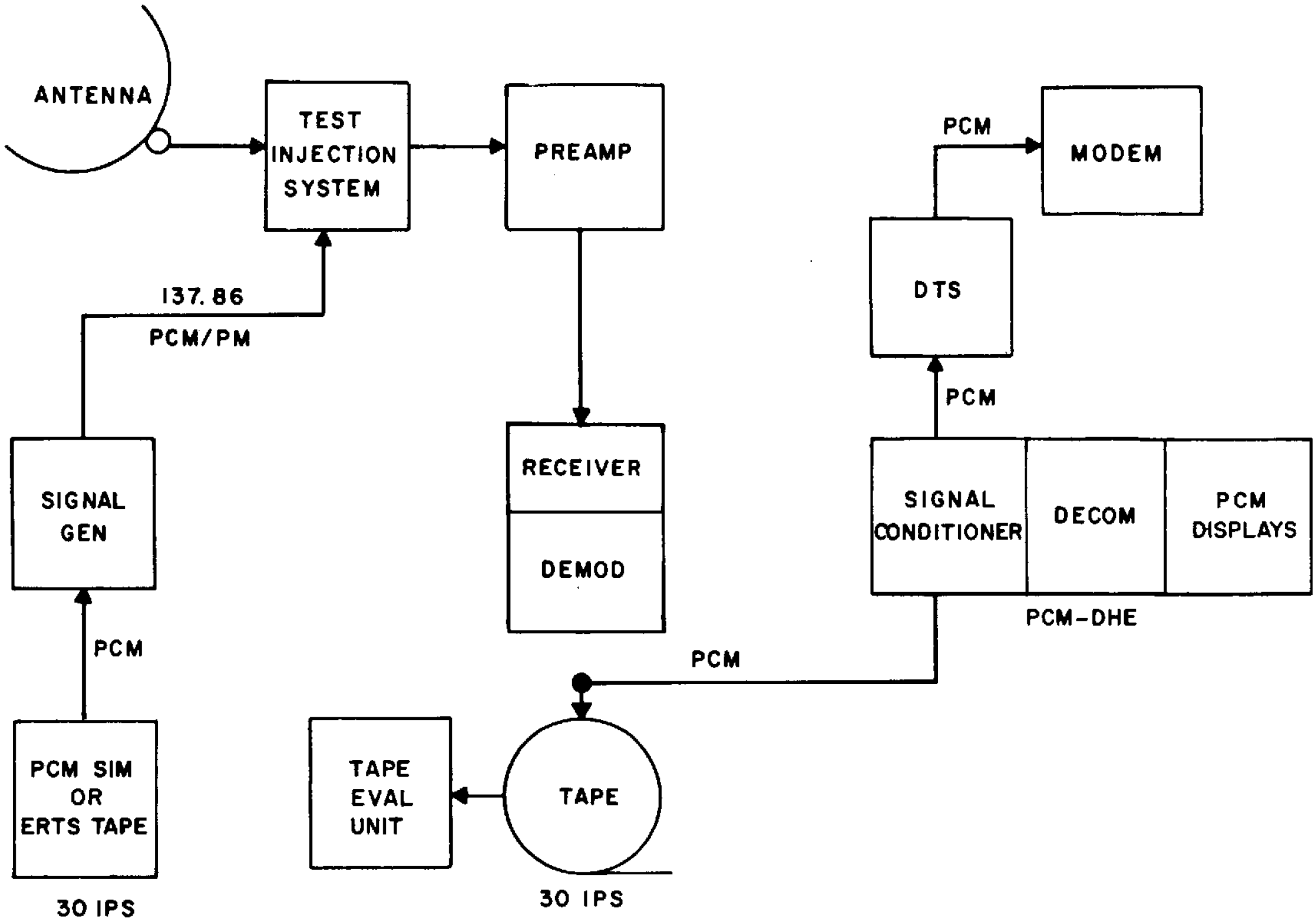


Figure 3-45. Real-time PCM Test Configuration

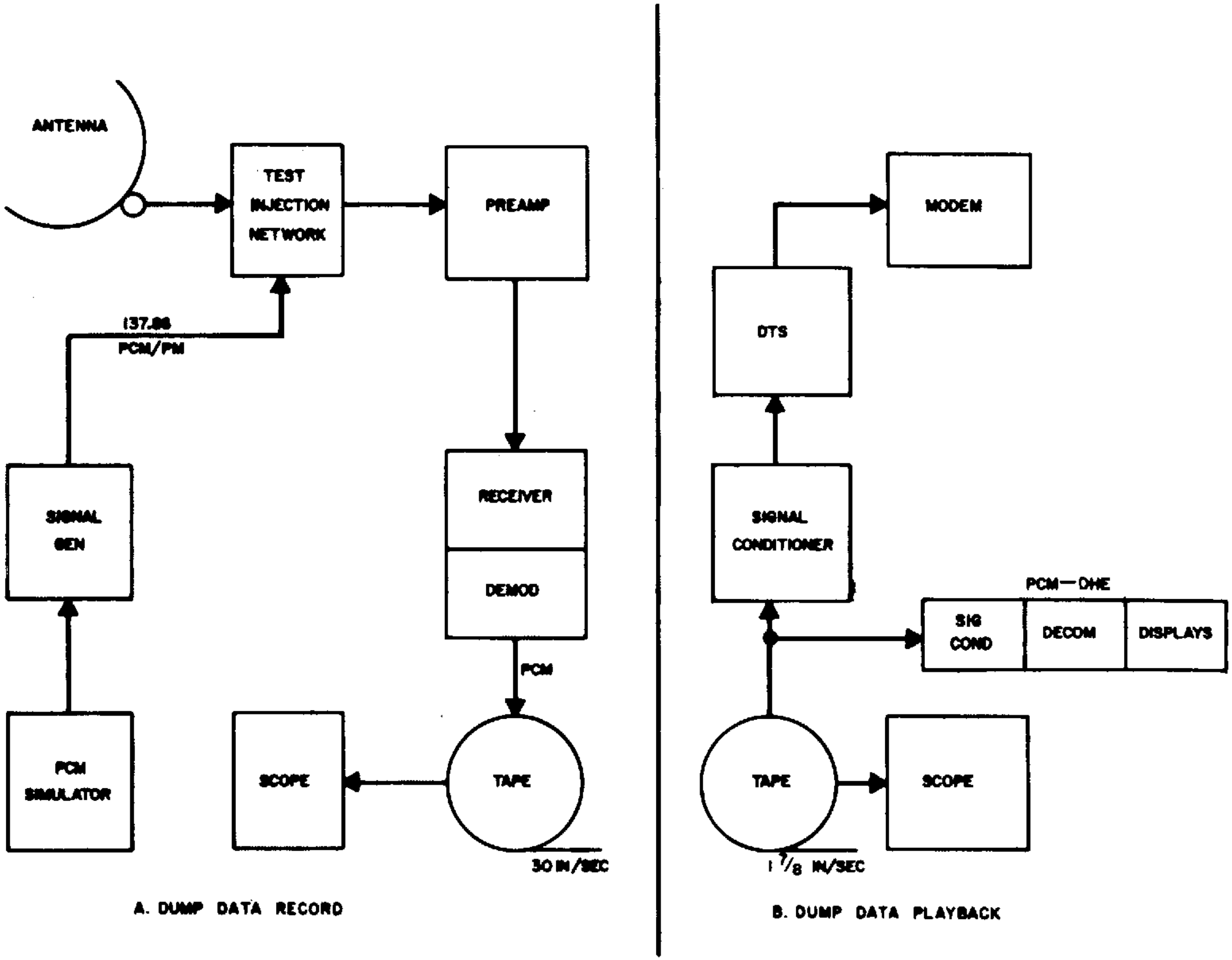


Figure 3-46. Dump Data Flow Test Configuration

3.4.2.3 Using the 136-MHz test injection system, inject a test signal of 137.86 MHz at an input power level of -110 dBm, at the preamplifier input.

3.4.2.4 Adjust the ERTS DUMP PCM modulation level of the signal generator for a modulation index of 1.14 radian. This corresponds to a reduction in carrier power of 8.2 dB. (Refer to Appendix C, para 2.)

3.4.2.5 Verify that the receiver video signal measures 2 Vpp (± 0.2) Vpp at the input to the tape recorders.

3.4.2.6 Record a short interval of PCM dump data at 30 in./sec. Verify the recorded data quality during this period.

3.4.2.7 Configure for the playback in accordance with instructions of the ERTS NOSP.

3.4.2.8 Configure additional PCM/DHE in parallel with the DTS system to monitor the reduced speed playback. (Fig 3-46 B.)

3.4.2.9 Play back the dump data at the 1-7/8 in./sec reduced speed. Confirm playback data quality via the PCM/DHE.

3.4.2.10 Verify proper operation of the DTS.

3.4.2.11 Reconfigure the system for operations.

4.1 DCS LOOP TEST

OBJECTIVE

The objective of this test is to verify proper operation of the DCS equipment prior to each spacecraft pass.

TEST DESCRIPTION

The test objective is accomplished by utilizing the DCS Self-test Unit (STU) in a short-loop mode to inject data into the DCS FM demodulator and to monitor the DCS equipment performance using the STU display counters.

Note

> This test is to be performed prior to each successive pass. The first of a series of pass support testing is covered under para 2.6.1.

TEST PROCEDURE

4.1.1 Verify that the STU noise circuit has been on at least 30 minutes prior to the start of testing.

4.1.2 Set up preliminary controls as specified in table 4-1.

4.1.3 On the STU, set the RUN/HOLD switch to RUN.

4.1.4 When the display readout reaches 20,000, set the RUN/HOLD switch to HOLD.

4.1.4.1 Press MESSAGE COUNTER and GOOD MESSAGE.

4.1.4.2 Subtract the new readout from the message count. The difference should be less than 960.

4.1.4.3 Press GOOD MESSAGE and MESSAGE ERROR.

4.1.4.4 The display readout should be less than 10.

4.1.5 Failure of the DCS system to meet the above criteria indicates that the system cannot process any data properly. If time does not permit equipment repairs, determine that there is a good 200-Hz IF output. The equipment can be repaired postpass and the data can be processed following repair.

4.1.6 Configure the DCS for mission support as specified in the NOSP.

Table 4-1. DCS Preliminary Setup

System Unit	Switch/Function	Position/Indication
MC	Press LAMP TEST	All lights remain ON
	Press RESET	All lights go OFF
TCR	POLARITY	+
	FWD/REV	FWD
	CODE	N3
FMD	Press LAMP TEST	All lights on when pressed
	PLAYBACK MODE	OFF
	VCO CONTROL	AUTO
	CHANNEL STATUS inhibits	All 6 off
BD	INPUT SOURCE SELECT	RECEIVER
CD	MODE	OPERATE
F/B	REQUEST TO SEND	OFF
	DATA SOURCE	DECODER
	MASTER CLEAR (1)	Press
	HEADER switches	Per STDN No. 601/ERTS
	BURST/CONT. (internal switch)	BURST
STU	MODE SELECT	TEST
	FM FSK/CW	FM FSK
	C/KT ADJUST	+2
	BURST/CONT.	BURST
	NOISE ON/NOISE OFF (2)	NOISE ON
	AUTO/MANUAL	AUTO

(1) MASTER CLEAR on the F/B must be pressed before the processing of any data.

(2) The NOISE ON/NOISE OFF has to be turned on at least 30 minutes prior to performing any test.

Table 4-1. DCS Preliminary Setup (cont)

System Unit	Switch/Function	Position/Indication
STU	VCO ON/VCO OFF	VCO ON
	TIME DELAY MSEC	6
	MESSAGE SELECT	PR
	STU/RECEIVER	STU
	RUN/HOLD	HOLD
	Press DISPLAY CLEAR	Display should be black
	MESSAGE COUNTER	Press ON
	GOOD MSG, BAD MSG, MSG ERROR	Press OFF
MC	Press RESET	All lights off

4.2 MSS PRE-PASS LOOP TEST

TEST OBJECTIVE

The objective of this test is to verify equipment configuration and nominal performance prior to each successive pass in which MSS data transmission is scheduled.

TEST DESCRIPTION

The test objective is accomplished by performing a brief end-to-end test of the on-site MSS equipment by injecting a simulated MSS RF signal into the parametric amplifier and verifying nominal post detection signal parameters.

Note

1. This test should be performed concurrently with the H-30 count and should be completed by H-10 minutes.

2. This test is redundant to paragraph 2.7 and need not be performed prior to the first pass following completion of prephase testing.

3. The ETC station TC is the coordinator for this test at ETC ERTS station and will require MSS data support from the ERTS OCC.

MSS PRE-PASS LOOP TEST

Seq	Operator	Instructions
1	USB/MFR/ MSS/RCDR *	Configure the equipment per figure 4-1, 4-2 or 4-3 as applicable. Verify that all equipment operating parameters and controls are set up per the NOSP (STDN 601/ERTS).
2	MSS *	Set the MSS test set controls as follows: Control — Setting PREAMBLE CONTROL — ALL DOWN PREAMBLE WORD — 000111 MNFS CONTROLS — ALL DOWN MNFS CODE — 001011 GENERAL WORD — 111111 UNIQUE WORD — 000000 UNIQUE SENSOR SEL — 01 SENSOR CH SEL — 01 ERROR WORD CODE — 000000 Control — Setting START SCAN CODE — 111000 SELF TEST SYNC SEL — N.A. TAPE/DEMUX sw — TAPE INT/EXT — INT ∿∿-DC — ∿∿-UNIQUE ALL BLACK CODE — NORMAL ALL WHITE CODE — NORMAL DISPLACED SSSC — NORMAL
3	USB/MFR	Set the MSS FM test transmitter to the downlink frequency and adjust the output level for a -85 dBm into the parametric amplifier.
4	USB/MFR/ MSS *	Adjust the level of the MSS data from the test set to frequency modulate the MSS test transmitter plus and minus 5.6 MHz.
5	MSS *	At the MSS bit synchronizer, verify that the SYNC indicator is illuminated and that the DATA indicator is extinguished.
6	MSS *	At the MSS demultiplexer, verify that the preamble search, preamble lock and MNFS lock indicators are illuminated.
7	MSS *	Connect a frequency counter to demultiplexer J-44. Set the counter function switch to frequency and time base switch to 10 sec. Verify zero error count on the frequency counter.

* For ETC testing, the MSS and RCDR operators are located at the OCC.

MSS PRE-PASS LOOP TEST (cont)

Seq	Operator	Instructions
8	MSS *	Set the MSS demultiplexer CHANNEL SELECT switch to channel 1, select the demux output to be displayed on the status monitor oscilloscope.
9	MSS *	Verify a triangular waveshape of 5.0 Vpp as displayed on the status monitor oscilloscope.
10	MSS *	Sequence the demultiplexer CHANNEL SELECT switch through channels 2 to 25/26 and verify a 5.0-volt dc level for each channel as displayed on the status monitor oscilloscope.
11	RCDR *	Connect an oscilloscope to monitor the input of the FR-1928 track 2. Verify the correct record level of the PCM data stream.
12	RCDR *	Repeat sequence 11 above to verify the PCM data inputs of tracks 3 through 26.
		<u>END OF TEST</u>

* For ETC testing, the MSS and RCDR operators are located at the OCC.

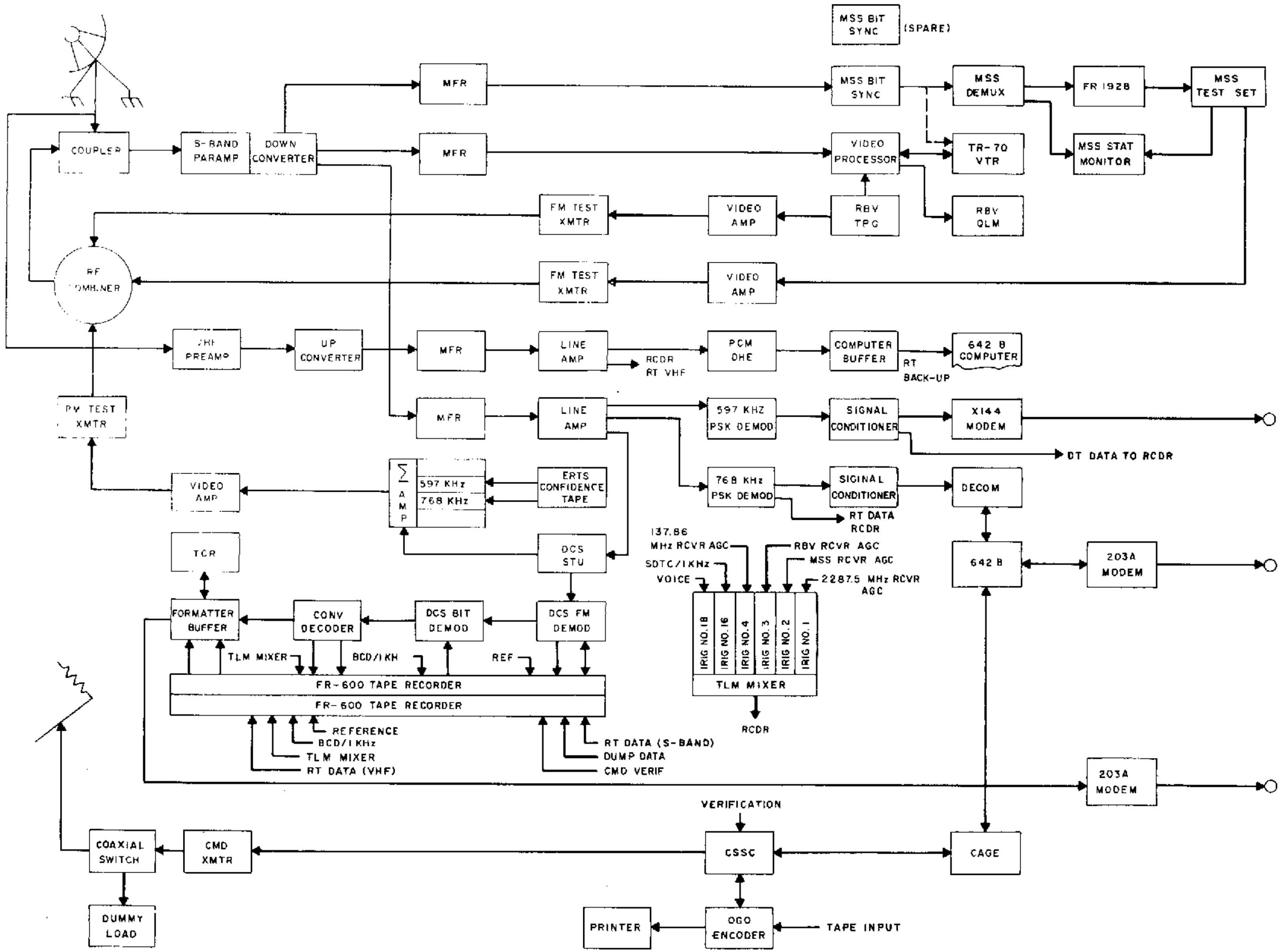


Figure 4-1. Prepass Loop Test Configuration (Alask ERTS Station)

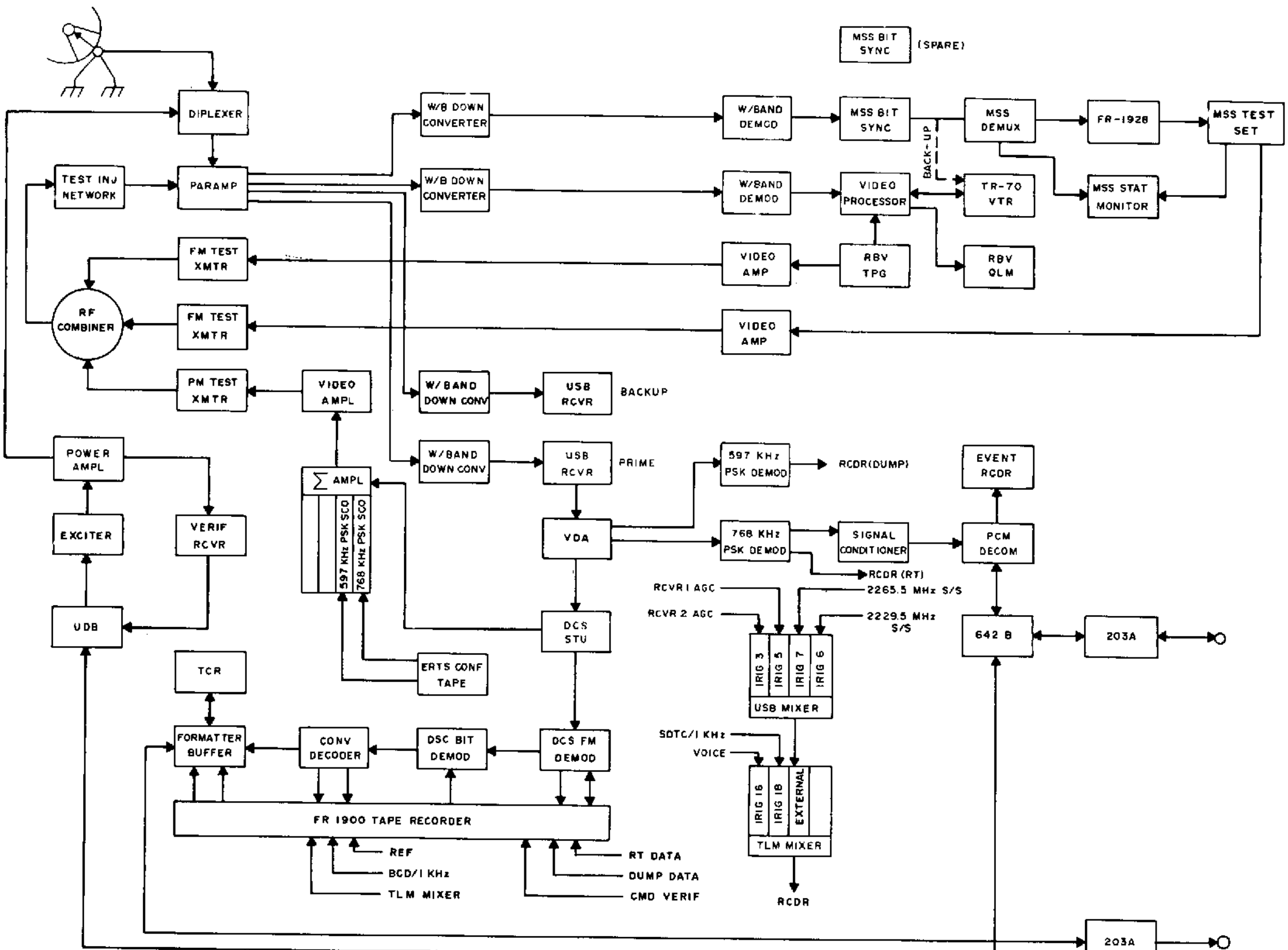


Figure 4-2. Prepass Loop Test Configuration (Goldstone ERTS Station)

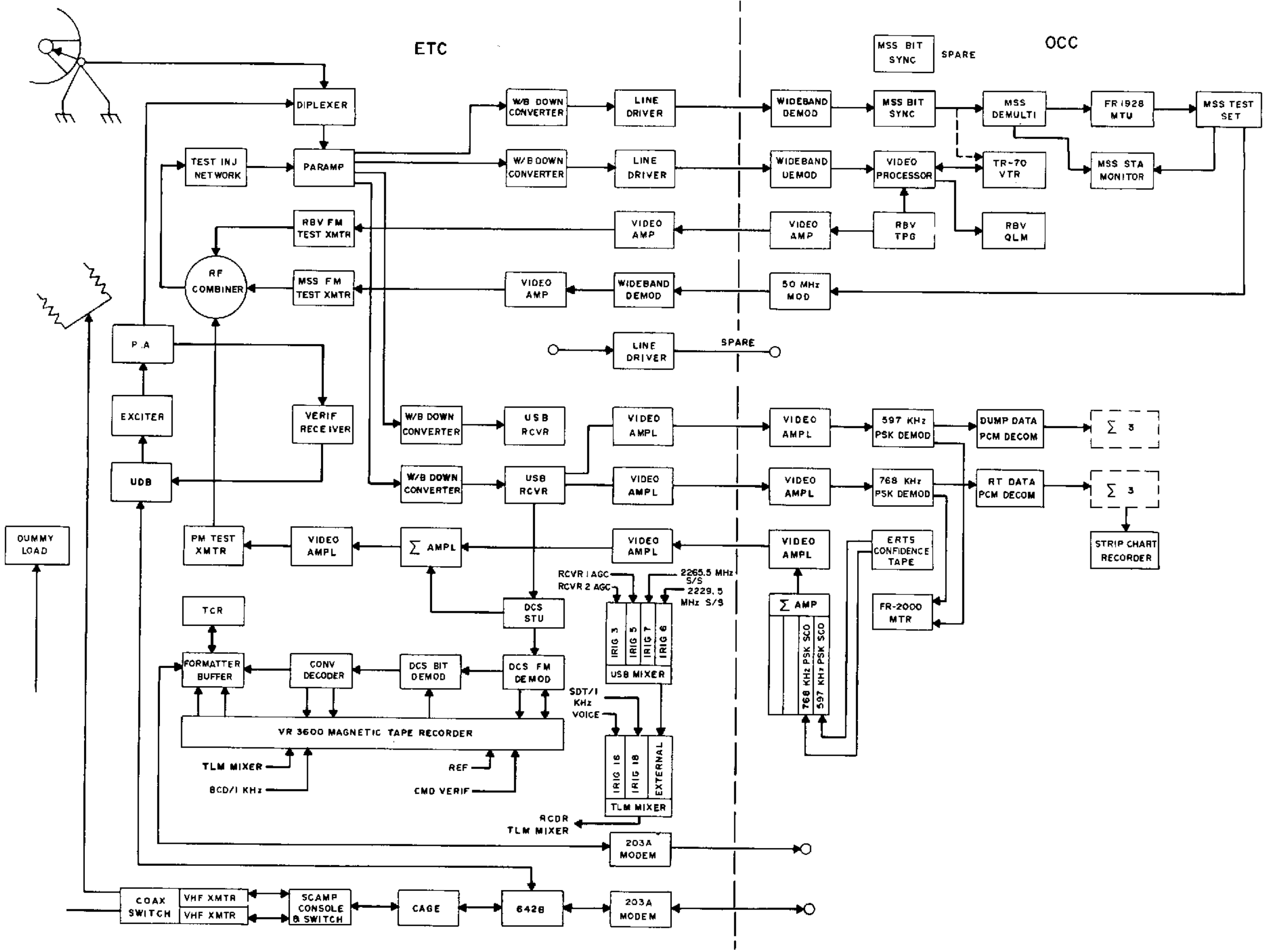


Figure 4-3. Prepass Loop Test Configuration (ETC/OCC ERTS Station)

4.3 RBV PRE-PASS LOOP TEST

TEST OBJECTIVE

The objective of this test is to verify equipment configuration and nominal performance prior to each successive pass in which RBV data transmission is scheduled.

TEST DESCRIPTION

The test objective is accomplished by performing a brief end-to-end test of the on-site RBV equipments by injecting a simulated RBV RF signal into the parametric amplifier and verifying nominal post detection signal parameters.

Note

1. This test should be performed concurrently with the H-30 count and should be completed by H-10 minutes.
2. This test is redundant to paragraph 2.8 and need not be performed prior to the first pass following completion of pre-phase testing.
3. The ETC station TC is the coordinator for this test at the ETC ERTS station and will require RBV data support from the ERTS OCC.

RBV PRE-PASS LOOP TEST

Seq	Operator	Instructions
1	RBV/RCDR/ USB/MFR *	Configure the equipment per figure 4-1, 4-2 or 4-3 as applicable. Verify that all equipment operating parameters and controls are set up per the NOSP (STDN No. 601/ERTS).
2	RBV *	Set the RBV TPG controls as follows: Control — Setting MODE SELECTION — NORMAL CYCLE — CONTINUOUS CAMERA #1 — ON CAMERA #2 — ON CAMERA #3 — ON CLOCK — INTERNAL FILTER — IN PATTERN SELECT — 20 (MULTIBURST)
3	MFR/USB	Set the RBV FM test transmitter to the downlink frequency and adjust the output level for a -85 dBm into the parametric amplifier.
4	MFR/USB/ RBV *	Adjust the level of the RBV video data from the RBV TPG to frequency-modulate the RBV FM test transmitter plus and minus 5.6 MHz.
5	RBV *	At the RBV video processor (VPASS), verify correct indication and sequencing of the VPASS front panel indicators. Verify normal display of the RBV video on the QLM.
6	RCDR*	Connect a true RMS voltmeter to VPASS J-8 (use patch panel connector corresponding to J-8). Remove modulation from the FM test transmitter and measure the RMS noise at J-8. Disconnect the voltmeter and connect an oscilloscope to VPASS J-8. Measure the amplitude of the horizontal sync edge (white level to sync tip) on the oscilloscope. Calculate S/N ratio and verify S/N ratio of 39 dB ±2 dB for Alaska or 41 dB ±2 dB for Goldstone and ETC/OCC. Note S/N (dB) = 20 log (Horizontal sync edge amplitude/RMS noise).

* For ETC testing, the RBV and RCDR operators are located at the OCC.

RBV PRE-PASS LOOP TEST (cont)

Seq	Operator	Instructions
7	RCDR *	Connect the CRO monitor to display the RBV data at the input to the TR-70 VTR.
8	RCDR *	Verify correct level of the video data and relative amplitudes of the burst frequencies as compared to the black and white reference levels.
9	RCDR *	Connect the TR-70 record and reproduce electronics in a back-to-back (E--E) mode. Connect the CRO monitor to display the reproduce video output. Repeat sequence 8 above.
10	RCDR *	Restore TR-70 record-reproduce electronics to the normal record configuration.
		<u>END OF TEST</u>

* For ETC testing, the RBV and RCDR operators are located at the OCC.

4.4 CMD AND TLM INTERFACE TEST

OBJECTIVE

The objective of this test is to ensure that the commands generated at the ERTS OCC, and that the telemetry generated on station can be reliably transmitted over NASCOM lines.

TEST DESCRIPTION

The objective is accomplished during the H-minus count by configuring the station to interface with the OCC, uplinking station and OCC generated commands, and processing telemetry from the paramp through the modems to the OCC.

TEST SETUP

Verify that the station is configured per STDN No. 601/ERTS.

Input the test parameters into the RF downlink system via the test injection network.

Terminate the PA into the dummy load.

TEST PROCEDURE

Perform the scripted test sequences in test script under the time lines outlined in the H-minus count.

Test Script

Seq	Operator	Instructions
1	RCDR	Mount the ERTS confidence tape (ECT) on the recorder, and set up the recorder to play back real-time and dump PCM data into the test injection network.
2	CMPTR	Reinitialize the computer and insert the rev number under OPSR direction.
3	RCDR	Set the ECT time, speed and start the recorder under OPSR direction.
4	OPSR	CAM for command mode 1 operations.
5	OPSR/RCDR	Start the ECT on cue from the ERTS Ground Equipment Supervisor (GES). Note ETC-ERTS will receive ECT data from the OCC and input it into the test injection network, then retransmit to the OCC. The GES will verify data quality on the turnaround.
6	OPSR	Initiate ERTS RTC's and COMDEC under GES direction, and report to GES that the commands were properly uplinked and verified.
7	OPSR	Initiate the CAM for command mode 2 operations, and report mode 2 configuration to the GES.
8	OPSR	Confirm proper receipt and uplink of OCC initiated commands and report command uplink to the GES.
9	OPSR/RCDR/ CMPTR	Stop the ECT and configure all equipment for real-time support on cue from the ERTS GES.

4.5 TRACKING SYSTEM AUTOTRACK TEST

OBJECTIVE

The objective of this test is to verify that the tracking system can autotrack.

TEST DESCRIPTION

The objective is accomplished by setting up the tracking system to autotrack the collimation tower.

TEST PROCEDURES

a. Perform the applicable parts of the Metric Data Tests in SRT section 2.3 for your station.

b. Move the antenna(s) to point to the IP under OPSR direction.

APPENDIX A

FM MODULATION SENSITIVITY TEST

The most convenient and accurate method of establishing the frequency deviation (Δf) of an FM signal source is to determine the test frequency (f_m) which produces a carrier null at the required deviation. The test frequency is then set to modulate the FM carrier to produce a carrier null which is easily monitored on a spectrum analyzer.

The test frequency which is the modulating frequency applied to the FM signal source is determined by the following formula:

$$M.I. = \frac{\Delta f}{f_m}$$

The first carrier null always occurs at a Modulation Index (M.I.) of 2.4. Substituting this in the above formula gives:

$$2.4 = \frac{\Delta f}{f_m} \qquad (1)$$

Substituting the carrier deviation for the ERTS wideband downlinks in (1) above:

$$2.4 = \frac{\Delta f}{f_m} = \frac{5.6 \text{ MHz}}{f_m}$$

Solving for f_m:

$$f_m = \frac{5.6 \text{ MHz}}{2.4}$$

$$= 2.333 \text{ MHz}$$

The correct modulating frequency to be applied to the FM signal source to obtain a carrier null at 5.6 MHz peak deviation is 2.333 MHz.

Two types of modulation are generally encountered in FM transmission links which are sine wave such as subcarriers and baseband data such as PCM, video, etc. The following procedures should be used for determining the correct deviation for the two types of modulating data.

1. FM BASEBAND DATA LINK

a. Connect the equipment as shown in figure A-1.

b. Set the FM signal generator to the downlink frequency to be tested.

c. With the test oscillator output disabled, adjust the FM signal generator output level and spectrum analyzer controls to display the unmodulated carrier on the spectrum analyzer.

d. Set the test oscillator to the test frequency (f_m) determined from (1) and enable the test oscillator output.

e. Beginning with minimum output from the test oscillator, slowly increase the output level of the test oscillator until the carrier level disappears into the base-line of the spectrum analyzer display.

f. Continue increasing the test oscillator output level until the carrier emerges from the baseline of the spectrum analyzer display.

g. Reset the test oscillator output level to the point halfway between disappearance of the carrier in step 1e and reappearance of the carrier in step 1f.

h. Measure the peak-to-peak amplitude of the test oscillator output on the oscilloscope. The peak-to-peak amplitude of the test frequency as measured on the oscilloscope is the peak-to-peak amplitude of the PCM or video signal necessary to deviate the signal generator to the required Δf.

2. FM SINE WAVE DATA LINK

a. Connect the equipment as shown in figure A-2.

b. Set the FM signal generator to the downlink frequency to be tested.

c. With the test oscillator output disabled, adjust the FM signal generator output level and spectrum analyzer controls to display the unmodulated carrier on the spectrum analyzer.

d. Set the test oscillator to the test frequency (f_m) determined from (1) and enable the test oscillator output.

e. Beginning with minimum output from the test oscillator, slowly increase the output of the test oscillator until the carrier level disappears into the baseline of the spectrum analyzer display.

f. Continue increasing the test oscillator output level until the carrier emerges from the baseline of the spectrum analyzer display.

g. Reset the test oscillator output level to the point halfway between disappearance of the carrier in step 2e and reappearance of the carrier in step 2f.

h. Measure the RMS amplitude of the test oscillator output on the true RMS voltmeter. The RMS amplitude of the test frequency as measured on the true RMS voltmeter is the RMS valve of the sine wave data necessary to deviate signal generator to the required Δf.

3. ERTS WIDEBAND DOWNLINK TEST FREQUENCY

The correct test frequency for the ERTS wideband downlinks is 2.333 MHz and paragraph 1 should be used to determine the modulation sensitivity.

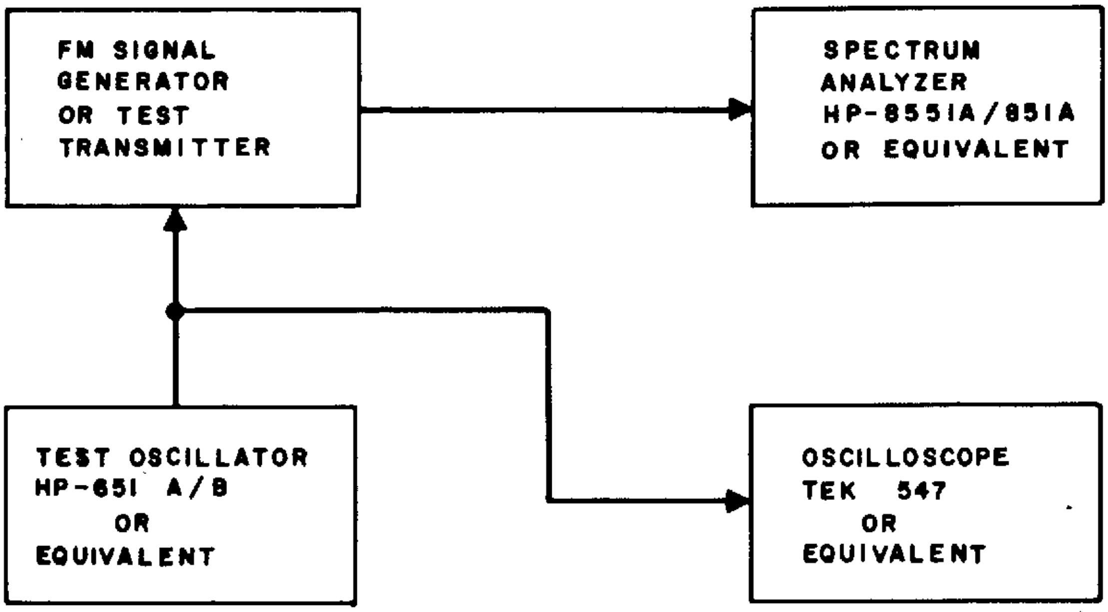


Figure A-1. Modulation Sensitivity Test

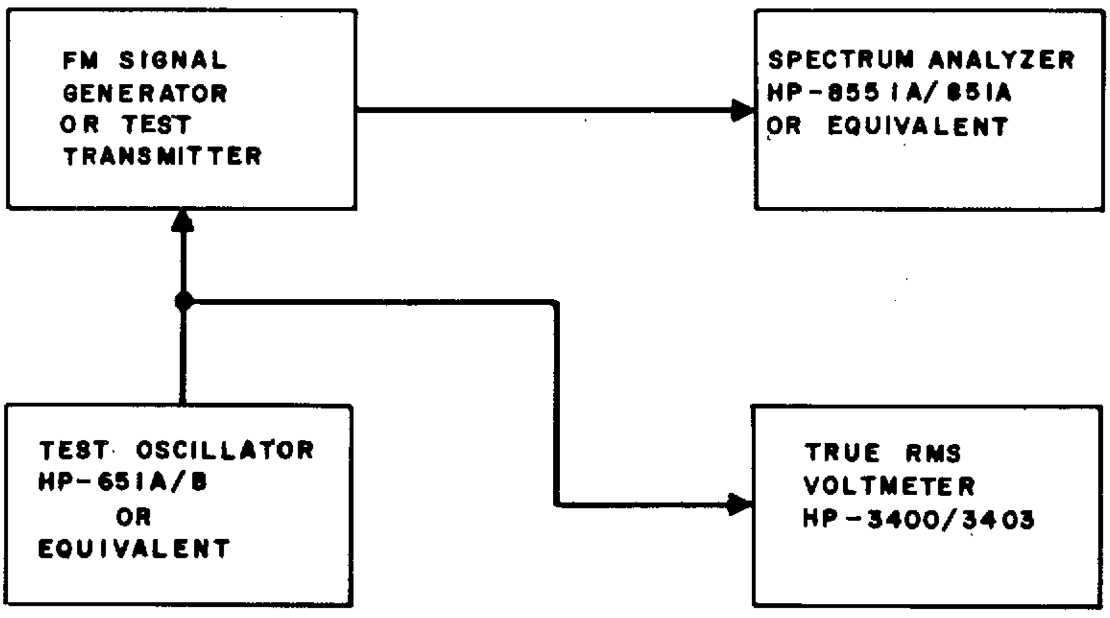


Figure A-2. Modulation Sensitivity Test

4. LAUNCH VEHICLE DOWNLINK TEST FREQUENCIES

The correct test frequencies for the launch vehicle downlink are as follows:

IRIG CHNL	f_m
1, 6, 7, 8, 9, 10, 11, 12, 13 and A	3.87 kHz
C	7.91 kHz
E	18.33 kHz
G	38.70 kHz
Composite	104.10 kHz

Paragraph 2 should be utilized in determining modulation sensitivity for the IRIG channels. Paragraph 1 should be used in determining the composite IRIG sensitivity since the composite signal will be a video signal.

APPENDIX B. TEST CRITERIA CALCULATIONS

1. WIDEBAND FM TEST CRITERIA CALCULATIONS

1.1 CARRIER-TO-NOISE RATIO (C:N)

System noise power $= P_n = kTB$

where:

P_n = Noise power in watts

k = Boltzmann's constant = 1.374×10^{-23}

T = System temperature in degrees Kelvin

B = Bandwidth in cycles (IF).

At GDS and ETC $T = 125^{\circ}$ K

B = 30 MHz

and $kTB = 1.374 \times 10^{-23} \times 1.25 \times 10^{2} \times 3.0 \times 10^{7}$

$= 1.374 \times 1.25 \times 3.0 \times 10^{-14}$ watts

$= 5.15 \times 10^{-11}$ milliwatts

and 10 log $kTB = -110 + 7.1$ dBm

For carrier power $(P_c) = P_n$: $P_c = -102.9$ dBm

For $P_c = -85$ dBm $C:N = -85 - (-102.9)$ dB

$= -85 + 102.9$ dB

$= 17.9$ dB

At ULA $T = 210^{\circ}$ K

B = 20 MHz

and $P_n = kTB$ $= -102.4$ dBm = 0 dB C:N

For $P_c = -85$ dBm: $C:N = 17.4$ dB

1.2 FM IMPROVEMENT FACTOR (MIF)

$$MIF = \frac{3\,(\Delta F)^2\, B_{IF}}{2\,(B_m)^3}$$

= S:N improvement

where:

F = peak deviation

= 5.6 MHz

B_{IF} = IF bandwidth

B_m = Video filter noise bandwidth

At GDS and ETC/OCC

$$B_{IF} = 30 \text{ MHz}$$
$$B_m = 10 \text{ MHz (MSS)}$$
$$B_m = 6 \text{ MHz (RBV)}$$
$$B_m = 3.7 \text{ MHz (RBV-VPASS)}$$

and for MSS:

$$MIF = \frac{3\,(5.6)^2 \times 30 \times 10^{18}}{2\,(10)^3 \times 10^{18}}$$
$$= \frac{45\,(31.4)}{1000}$$
$$= 1.42$$

For RBV:

$$MIF = \frac{3\,(5.6)^2 \times 30 \times 10^{18}}{2\,(6)^3 \times 10^{18}}$$
$$= \frac{45\,(31.4)}{216}$$
$$= 6.55$$

For RBV-VPASS:

$$MIF = \frac{3\,(5.6)^2 \times 30 \times 10^{18}}{2\,(3.7)^3 \times 10^{18}}$$
$$= \frac{45\,(31.4)}{50.6}$$
$$= 27.9$$

At ULA

$$B_{IF} = 20 \text{ MHz}$$
$$B_m = 10 \text{ MHz (MSS)}$$
$$B_m = 5 \text{ MHz (RBV)}$$
$$B_m = 3.7 \text{ MHz (RBV-VPASS)}$$

And for MSS:

$$MIF = \frac{3\,(5.6)^2 \times 20 \times 10^{18}}{2\,(10)^3 \times 10^{18}}$$
$$= \frac{30\,(31.4)}{1000}$$
$$= 0.942$$

For RBV:

$$MIF = \frac{3\,(5.6)^2 \times 20 \times 10^{18}}{2\,(5)^3 \times 10^{18}}$$
$$= \frac{30\,(31.4)}{125}$$
$$= 7.53$$

For RBV-VPASS:

$$MIF = \frac{3\,(5.6)^2 \times 20 \times 10^{18}}{2\,(3.7)^3 \times 10^{18}}$$
$$= \frac{30\,(31.4)}{50.6}$$
$$= 18.6$$

1.3 SIGNAL-TO-NOISE RATIO (S:N)

$S{:}N_0$ = (C:N) (MIF) (video correction factor)

where: Video correction factor is the term applied to the calculated S_{rms}/N_{rms} to $S{:}N_{rms}$ where the signal is measured in other than rms values.

1.3.1 MSS S:N RATIOS

At ULA, at -85 dBm into the parametric amplifier:

$$C{:}N = 17.4 \text{ dB}$$
$$MIF = 0.942$$
$$= -0.25 \text{ dB}$$
$$VCF = S_{0-p}/S_{rms}$$
$$= 1.414/1$$
$$= 3 \text{ dB}$$

and

$$S{:}N_0 = (17.4 - 0.25 + 3) \text{ dB}$$
$$= 20.15 \text{ dB at FM demod output}$$

At GDS and ETC/OCC, at -85 dBm into the parametric amplifier:

$$C{:}N = 17.9 \text{ dB}$$
$$MIF = 1.42$$
$$= 1.54 \text{ dB}$$
$$VCF = 3 \text{ dB}$$

and

$$S{:}N_0 = (17.9 + 1.54 + 3) \text{ dB}$$
$$= 22.4 \text{ dB at FM demod output}$$

1.3.2 RBV S:N RATIOS

At ULA, at -85 dBm into the parametric amplifier:

$$C{:}N = 17.4 \text{ dB}$$
$$MIF = 7.53 \text{ (FM demod output)}$$
$$MIF = 18.6 \text{ (VPASS filtered output)}$$
$$VCF = 2.83/1$$

and

$$S{:}N_0 = (17.4 + 10 \log 7.53 + 20 \log 2.83) \text{ dB}$$
$$= (17.4 + 8.8 + 9) \text{ dB}$$
$$= 35.2 \text{ dB at FM demod output}$$

also

$$= (17.4 + 10 \log 18.6 + 9) \text{ dB}$$
$$= (17.4 + 12.7 + 9) \text{ dB}$$
$$= 39.1 \text{ dB at VPASS filtered output}$$

At GDS and ETC/OCC, at -85 dBm into the parametric amplifier:

$$C:N = 17.9 \text{ dB}$$

$$MIF = 6.55 \text{ (at FM demod output)}$$

$$MIF = 27.9 \text{ (at VPASS filter output)}$$

$$VCF = 2.83/1$$

and

$$\begin{aligned} S:N &= (17.9 + 10 \log 6.55 + 20 \log 2.83) \text{ dB} \\ &= (17.9 + 8.2 + 9) \text{ dB} \\ &= 35.1 \text{ dB at demod output} \end{aligned}$$

also

$$\begin{aligned} &= (17.9 + 10 \log 27.9 + 9) \text{ dB} \\ &= (17.9 + 14.5 + 9) \text{ dB} \\ &= 41.4 \text{ dB at VPASS filtered output} \end{aligned}$$

1.4 MSS BIT ERROR RATE

MSS 10^{-5} BER carrier level = 0 dB C:N level + signal conditioner input S:N ratio (15.6 dB required) - (MIF + VCF)

For ULA, 10^{-5} BER = -102.4 dBm + 15.6 dB - (-0.25 + 3) dB
= -89.55 dB

For GDS and ETC/OCC, 10^{-5} BER = -102.9 dBm + 15.6 dB - (1.54 + 3) dB
= -91.84 dBm

2. S-BAND PM TEST CRITERIA CALCULATIONS

2.1 MODULATION LOSS CALCULATIONS

The following formulas are utilized to calculate the modulation loss of the carrier and subcarriers with respect to the unmodulated carrier or total received power (TRP) and TRP = unmodulated carrier power.

$$P_{carrier/TRP} = J_0^2\left(\theta_{RT}\right) J_0^2\left(\theta_{DUMP}\right) J_0^2\left(\theta_{DCS}\right) \quad (1)$$

$$P_{RT\ subcarrier/TRP} = 2J_1^2\left(\theta_{RT}\right) J_0^2\left(\theta_{DUMP}\right) J_0^2\left(\theta_{DCS}\right) \quad (2)$$

$$P_{DUMP\ subcarrier/TRP} = J_0^2\left(\theta_{RT}\right) 2J_1^2\left(\theta_{DUMP}\right) J_0^2\left(\theta_{DCS}\right) \quad (3)$$

$$P_{DCS\ subcarrier/TRP} = J_0^2\left(\theta_{RT}\right) J^2\left(\theta_{DUMP}\right) 2J_1^2\left(\theta_{DCS}\right) \quad (4)$$

where: θ_{RT} = Modulation index of RT data subcarrier

θ_{DUMP} = Modulation index of dump data subcarrier

θ_{DCS} = Modulation index of DCS data subcarrier

J_x = Bessel function

and θ_{RT} = 0.30 radians

$$J_0^2\ (0.30) = (0.9776)^2 \tag{5}$$

$$J_1^2\ (0.30) = (0.1483)^2 \tag{6}$$

θ_{DUMP} = 0.81 radians

$$J_0^2\ (0.81) = (0.8425)^2 \tag{7}$$

$$J_1^2\ (0.81) = (0.3726)^2 \tag{8}$$

θ_{DCS} = 0.99 radians

$$J_0^2\ (0.99) = (0.7695)^2 \tag{9}$$

$$J_1^2\ (0.99) = (0.4368)^2 \tag{10}$$

substituting (5), (7), and (9) in (1) above gives

$$P_{c/TRP} = (0.9776)^2\ (0.8425)^2\ (0.7695)^2$$

and $10 \log P_c$ $= 20 \log (9.776/10) + 20 \log (8.425/10) + 20 \log (7.695/10)$

$= 20\ (0.990 - 1 + 0.926 - 1 + 0.886 - 1)$

$= (-60 + 56.0)$ dB

$= -4.0$ dB

$$P_{RT/TRP} = 2(0.1483)^2\ (0.8425)^2\ (0.7695)^2 \tag{11}$$

and $10 \log P_{RT}$ $= 10 \log 2 + 20 \log (0.1483) + 20 \log (0.8425) + 20 \log (0.7695)$

$= 3 + 20\ (0.171-1+0.926-1+0.886-1)$

$= (3-60 + 39.6)$ dB

$= -17.4$ dB

$$P_{DUMP/TRP} = (0.9776)^2\ 2(0.3726)^2\ (0.7695)^2 \tag{12}$$

and $10 \log P_{DUMP}$ $= 20 \log (0.9776) + 10 \log 2 + 20 \log (0.3726) + 20 \log (0.7695)$

$= 20\ (0.990-1+0.572-1+0.886-1) + 3$

$$= (3\text{-}60 + 49.00) \text{ dB}$$

$$= -8.0 \text{ dB} \qquad (13)$$

$$P_{DCS/TRP} = (0.9776)^2 (0.8425)^2 \, 2 \, (0.4368)^2$$

$$\text{and } 10 \log P_{DCS} = 20 \log (0.9776) + 20 \log (0.8425) + 10 \log 2 + 20 \log (0.4368)$$

$$= 20 (0.990\text{-}1+0.926 - 1 + 0.641\text{-}1) +3$$

$$= (3\text{-}60 + 51.1) \text{ dB}$$

$$= -5.9 \text{ dB} \qquad (14)$$

2.2 REAL-TIME (RT) DATA BIT ERROR RATE

PSK Demodulator input signal-to-noise ratio (S:N) required for 10^{-6} BER per MFG specifications:

$$S{:}N = 9.2 \text{ dB (in BW/BR of 3.0)}$$

$$\text{and } \quad S = N + 9.2 \text{ dB} \qquad (15)$$

where N = kTB:

$$k = 1.374 \times 10^{-23}$$

$$B = 3.0 \times 10^3$$

$$T = 1.25 \times 10^2 \text{ (GDS and ETC)}$$

$$T = 2.10 \times 10^2 \text{ (ULA)}$$

$$T = 1.00 \times 10^2 \text{ (USB cooled)}$$

$$T = 1.76 \times 10^2 \text{ (USB Micro-Mega)}$$

$$T = 2.50 \times 10^2 \text{ (USB warm)}$$

Solving (15)

$$S = 10 \log (1.374 \times 3.0 \times 1.25 \times 10^{-15}) \text{ dBm} + 9.2 \text{ dB}$$

For GDS/ETC:

$$= -150 + 7.1 + 9.2 \text{ dBm}$$

$$= -133.7 \text{ dBm} \qquad (16)$$

$$= \text{Signal power required for BER} = 10^{-6}$$

By definition:

Signal power + modulation loss = TRP

and carrier power + carrier suppression = TRP

∴ Signal power + mod loss = carrier power + carrier suppression

and carrier power = signal power + mod loss - carrier suppression, substituting (11), (12), and (16) above.

$$\text{Carrier power} = -133.7 \text{ dBm} + 17.4 \text{ dB} - 4.0 \text{ dB}$$

$$= -120.3 \text{ dBm (GDS and ETC)}$$

Repeating the above calculations and substituting the appropriate system temperature yields:

$$\text{ULA} = -118.1 \text{ dBm } (T_s = 210^\circ K)$$

$$\text{USB cooled} = -121.3 \text{ dBm } (T_s = 100^\circ K)$$

$$\text{USB Micro-Mega} = -118.8 \text{ dBm } (T_s = 176^\circ K)$$

2.3 PLAYBACK (DUMP) DATA BIT ERROR RATE

PSK Demodulator input (S:N) required for 10^{-6} BER:

$$S:N = 9.2 \text{ dB (in BW/BR of 3.0)}$$

and

$$S = \text{Noise} + 9.2 \text{ dB} \tag{17}$$

where noise = kTB:

$$k = 1.374 \times 10^{-23}$$

$$B = 7.2 \times 10^4$$

$$T = 1.25 \times 10^2 \text{ (GDS and ETC)}$$

$$T = 2.10 \times 10^2 \text{ (ULA)}$$

$$T = 1.00 \times 10^2 \text{ (USB cooled)}$$

$$T = 1.76 \times 10^2 \text{ (USB Micro-Mega)}$$

$$T = 2.50 \times 10^2 \text{ (USB warm)}$$

solving (17)

$$S = 10 \log (1.374 \times 7.2 \times 1.25 \times 10^{-14}) \text{ dBm} + 9.2 \text{ dB}$$

$$= -140 + 11 + 9.2 \text{ dBm}$$

$$= \boxed{-119.8 \text{ dBm}}$$

$$= \text{Signal power required for BER} = 10^{-6} \tag{18}$$

$$\text{Carrier power} = \text{Signal power} + \text{mod loss} - \text{carrier suppression}$$

$$= -119.8 \text{ dBm} + 8.0 \text{ dB} - 4.0 \text{ dB}$$

$$= \boxed{-115.8 \text{ dBm}} \text{ (GDS and ETC)}$$

$$= \boxed{-113.6 \text{ dBm}} \text{ ULA}$$

$$= \boxed{-116.8 \text{ dBm}} \text{ USB cooled}$$

$$= \boxed{-114.3 \text{ dBm}} \text{ USB Micro-Mega}$$

2.4 DCS DATA MESSAGE ERROR RATE

DCS FM Demodulator input S:N required:

S:N = 2 dB (in 100 kHz BW)

and S = N + 2.0 dB

where noise = kTB:

S = kTB + 2 dB

$k = 1.374 \times 10^{-23}$

T = 125°K

T = 210°K (ULA)

B = 100 kHz

$S = 10 \log (1.374 \times 1.25 \times 1.0 \times 10^{-13}) + 2$ dB

= -130 + 2.4 + 2.0 dBm

= -125.6 dBm

= Signal power required

Carrier power = Signal power + mod loss - carrier suppression

= -125.6 + 5.9 - 4.0 dBm

= -123.7 dBm

for ULA

Carrier power $= -123.7 \text{ dBm} - 10 \log\left(\frac{125}{210}\right)$

= -123.7 dBm + 2.2 dB

= -121.5 dBm

It should be noted that the above figures are valid only with the noise source turned off at the STU. Simulating expected mission conditions the noise source at the STU must be ON and the C/kT ADJUST set to + 3. The following calculation is used to determine the S:N in the link required for a 2-dB S:N out and + 3 C/kT ADJUST setting:

$$S{:}N = \frac{1}{\frac{1}{S{:}N_{in}} + \frac{1}{S{:}N_{Link}} + \frac{1}{S{:}N_{in}\,S{:}N_{Link}}}$$

$$\text{or } 1.6 = \frac{1}{\frac{1}{2} + \frac{1}{S{:}N_{Link}} + \frac{1}{2\ \ S{:}N_{Link}}}$$

$$\text{and } \frac{1}{2} + \frac{1}{S{:}N_{Link}} + \frac{1}{2\ S{:}N_{Link}} = \frac{1}{1.6}$$

$$\text{or } \frac{S{:}N}{2\ S{:}N_{Link}} + \frac{2}{2\ S{:}N_{Link}} + \frac{1}{2\ S{:}N_{Link}} = \frac{1}{1.6}$$

$$1.6\ S{:}N_{Link} + 3.2 + 1.6 = 2\ S{:}N_{Link}$$

$$4.8 = 0.4\ S{:}N_{Link}$$

$$S{:}N = 12.0$$

$$= 10.8\ \text{dB}$$

for GDS and ETC: $P_c = -123.7 + 10.8 - 2$ dBm

$= -123.7 + 8.8$

$= -114.9$ dBm

for ULA $P_c = -114.9$ dBm $-114.8 + 2.2$ dBm

$= -112.7$ dBm

3. LAUNCH VECHICLE FM DOWNLINK TEST CRITERIA CALCULATIONS

For USB support using the Motorola FM demodulator with no post-detection filter ($B_m = 1.6$ MHz), cooled paramp, and -94 dBm into the paramp:

$$S{:}N_{out} = \frac{3D^2 B_{IF}\ C{:}N_{in}}{2\ B^3_m}$$

where: $D = 249$ kHz

$B_{IF} = 5.0$ MHz

$C = -94\ \text{dBm} = 4 \times 10^{-10}$ mW

$N = kTB$

$B_m = 1.6$ MHz

$K = 1.374 \times 10^{-20}$

$T = 100\ ^{\circ}K$

$B = 5$ MHz

$$= \frac{3(2.49 \times 10^{5})^2 (5 \times 10^6)(4.0 \times 10^{-10}/6.9 \times 10^{-12})}{2\ (1.6 \times 10^6)^3}$$

$$= \frac{3 \times 24.8 \times 5 \times 10^6}{2 \times 4.1 \times 6.9 \times 10^6}$$

$$= \frac{372}{57}$$

$$= 6.6$$

$$= 8.2 \text{ dB*}$$

For USB support using the Motorola FM Demodulator with a 500-kHz post-detection filter (B_m = 500 kHz), cooled paramp, and -94 dBm into the paramp:

$$S{:}N_{out} = \frac{3\,(2.49 \times 10^5)^2\,(5 \times 10^6)\,(4.0 \times 10^{-10}/6.9 \times 10^{-12})}{2\,(5 \times 10^5)^3}$$

$$= \frac{3 \times 24.8 \times 5 \times 10^6}{2\,(125) \times 6.9 \times 10^3}$$

$$= \frac{3720}{1725} \text{ X } 10^2$$

$$= 216$$

$$= 23.4 \text{ dB*}$$

For the VHF/down-converter configuration with -94 dBm into the parametric amplifier:

$$S{:}N_{out} = \frac{3D^2\,B_{IF}\,C{:}N_{in}}{2\,B_m^{\,3}}$$

where: B_{IF} = 500 kHz

B_m = 300 kHz

$$= \frac{3(2.49 \times 10^5)^2\,(5.0 \times 10^5)\,(4.0 \times 10^{-10}/6.9 \times 10^{-13})}{2\,(3 \times 10^5)^3}$$

$$= \frac{3 \times 24.8 \times 5.0 \times 10^5}{2 \quad (27) \quad (6.9) \times 10^2}$$

$$= \frac{372.0}{372.0} \times 10^3$$

$$= 1000$$

$$= 30.0 \text{ dB*}$$

*If a Micro-Mega uncooled paramp is used, these figures must be reduced by a factor of 10 log (176/100) or 2.5 dB.

4. $\frac{S + N}{N}$ TO $S{:}N_{dB}$ CONVERSION

$$S{:}N_{dB} = 10 \log_{10} \left(\frac{S + N}{N} - 1\right)$$

where S + N and N are power measurements.

APPENDIX C. PHASE MODULATION INDEX SETUP

1. S-BAND PHASE MODULATION (PM) INDEX SETUP

1.1 GENERAL

Special care must be exercised in setting up the modulation indices of the simulated ERTS downlink due to the very low modulation index (0.30 radian) of the real-time (RT) data subcarrier. USB stations may use the normal procedure for setting the simulated downlink modulation indices using the wave analyzer and digital voltmeter to measure the carrier suppression of the 20-kHz carrier. The following procedure may be used at any S-band station for accurately establishing the simulated ERTS downlink modulation indices. PCM data need not be present on the subcarriers while setting up the modulation indices. USB backup stations should use one of the PSK simulator channels to simulate the DCS 1.024-MHz subcarrier. Prime ERTS stations will utilize the DCS STU 1.024-MHz FSK output connected to PSK simulator external input No. 1.

1.2 PROCEDURES

1.2.1 Configure the equipment as shown in figure C-1.

1.2.2 Set up one channel of the PSK simulator to simulate the 768-kHz RT data subcarrier and a second channel to simulate the 597-kHz dump data subcarrier.

1.2.3 Connect the 1.024-MHz FSK output from the DCS STU to one of the PSK simulator external mixer inputs (USB backup stations should use a third channel of the PSK simulator to simulate the DCS 1.024-MHz subcarrier).

1.2.4 Disable all PSK simulator SCO channels and mixer external inputs.

1.2.5 With no modulation applied to the test transmitter, tune the spectrum analyzer and adjust the variable attenuator to obtain the carrier spectrum of figure C-2 with linear vertical display selected on the 851B.

1.2.6 Set the variable attenuator for a convenient reference level and adjust the 8551B/851B controls for full scale (7 divisions) linear display of the unmodulated carrier spectrum.

1.2.7 Note the reference level setting of the variable attenuator.

1.2.8 Increase the attenuation of the variable attenuator by 16.6 dB and note the amplitude of the attenuated carrier as measured on the 851B. The amplitude of the attenuated carrier should be approximately 1.0 division as shown in figure C-3.

1.2.9 Reset the variable attenuator to the reference level noted in step 1.2.7 and verify full scale deflection (7 divisions) on the 851B.

1.2.10 At the PSK simulator, enable the 768-kHz SCO channel and adjust the output level to obtain subcarrier sideband levels equal in amplitude to the carrier level noted in step 1.2.8 (refer to figure C-4).

1.2.11 At the PSK simulator, disable the 768-kHz SCO channel and verify that the carrier amplitude as displayed on the 851B measures full scale (7 divisions).

1.2.12 Increase the attenuation of the variable attenuator by 8.6 dB and note the amplitude of the carrier as measured on the 851B (refer to figure C-5).

1.2.13 Reset the variable attenuator to the reference level setting of step 1.2.7 and verify that carrier amplitude as displayed on the 851B measures full scale (7 divisions).

1.2.14 At the PSK simulator, enable the 597-kHz SCO channel and adjust the SCO channel level to obtain subcarrier sideband levels equal in amplitude to the carrier level noted in step 1.2.12 (refer to figure C-6).

1.2.15 At the PSK simulator, disable the 597-kHz SCO channel and verify that the carrier amplitude as displayed on the 851B measures full scale (7 divisions).

1.2.16 Increase the attenuation of the variable attenuator by 7.2 dB and note the amplitude of the carrier as measured on the 851B (refer to figure C-7).

1.2.17 Reset the variable attenuator to the reference level setting of step 1.2.7 and verify that the carrier amplitude as displayed on the 851B measures full scale (7 divisions).

1.2.18 At the PSK simulator, enable the 1.024-MHz DCS subcarrier and adjust the subcarrier level to obtain the subcarrier sideband levels equal in amplitude to the carrier level noted in step 1.2.16 (refer to figure C-8).

1.2.19 At the PSK simulator, enable the 597-kHz and 768-kHz subcarrier channels and verify the composite spectrum as shown in figure C-9.

2. VHF PHASE MODULATION (PM) INDEX SETUP

2.1 GENERAL

The measurement of carrier power reduction versus modulation index will be used to determine the required modulation index.

2.2 PROCEDURES

2.2.1 Using the signal generator, insert a -90 dBm unmodulated signal (CW) into the test injection system of the telemetry system.

2.2.2 Set the receiver gain control mode to AGC and measure the AGC voltage at the demodulator.

2.2.3 Set the receiver gain control mode switch to the manual position and adjust the manual gain control until the AGC voltage of the demodulator matches the voltage value in step 2.2.2.

2.2.4 Attenuate the CW signal by 8.2 dB (for either RT or DUMP MODE) and MARK the demodulator AGC voltage.

2.2.5 Return the attenuator setting to -90 dBm.

2.2.6 Connect the modulating source to the input of the signal generator and increase the input gain (modulating source) slowly to match the demodulator AGC carrier drop value as measured in step 2.2.4.

2.2.7 Return the receiver to AGC mode.

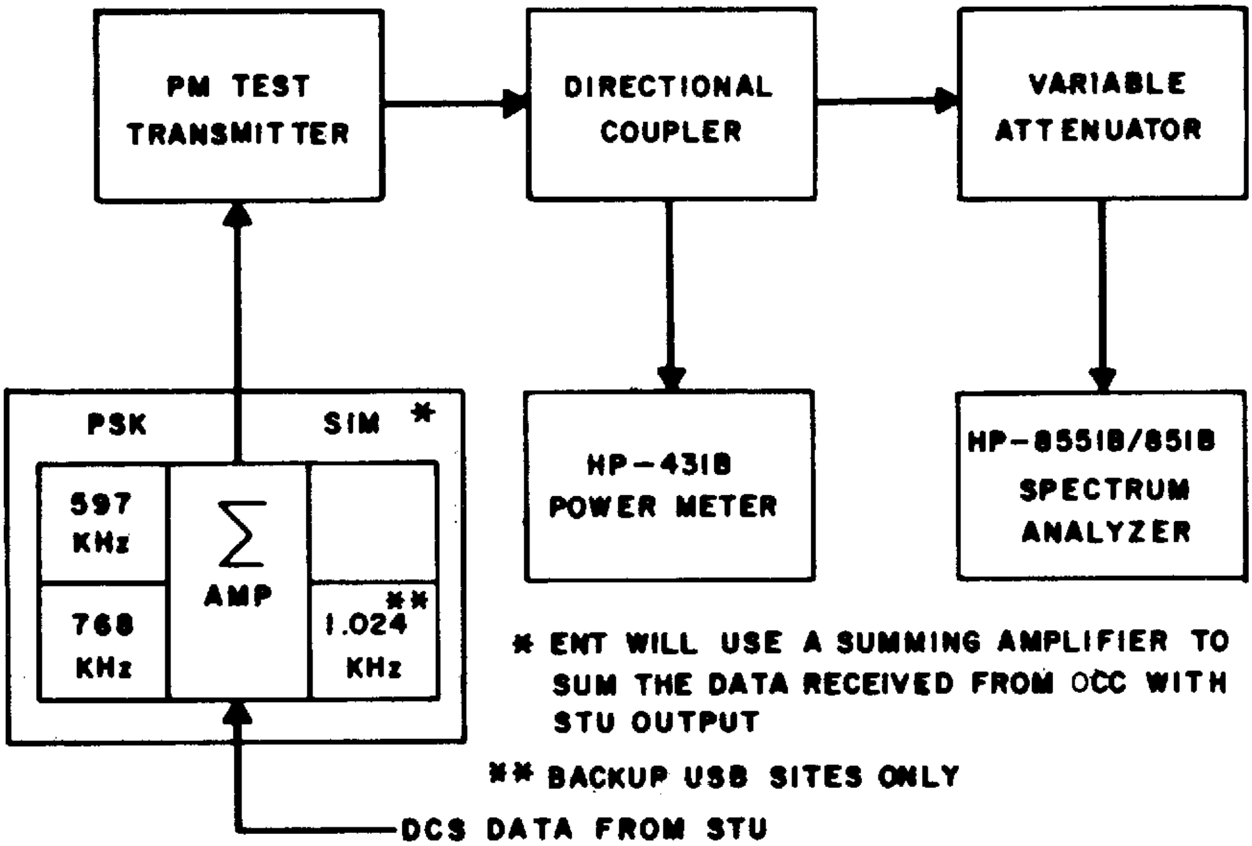


Figure C-1. PM Modulation Index Test Setup

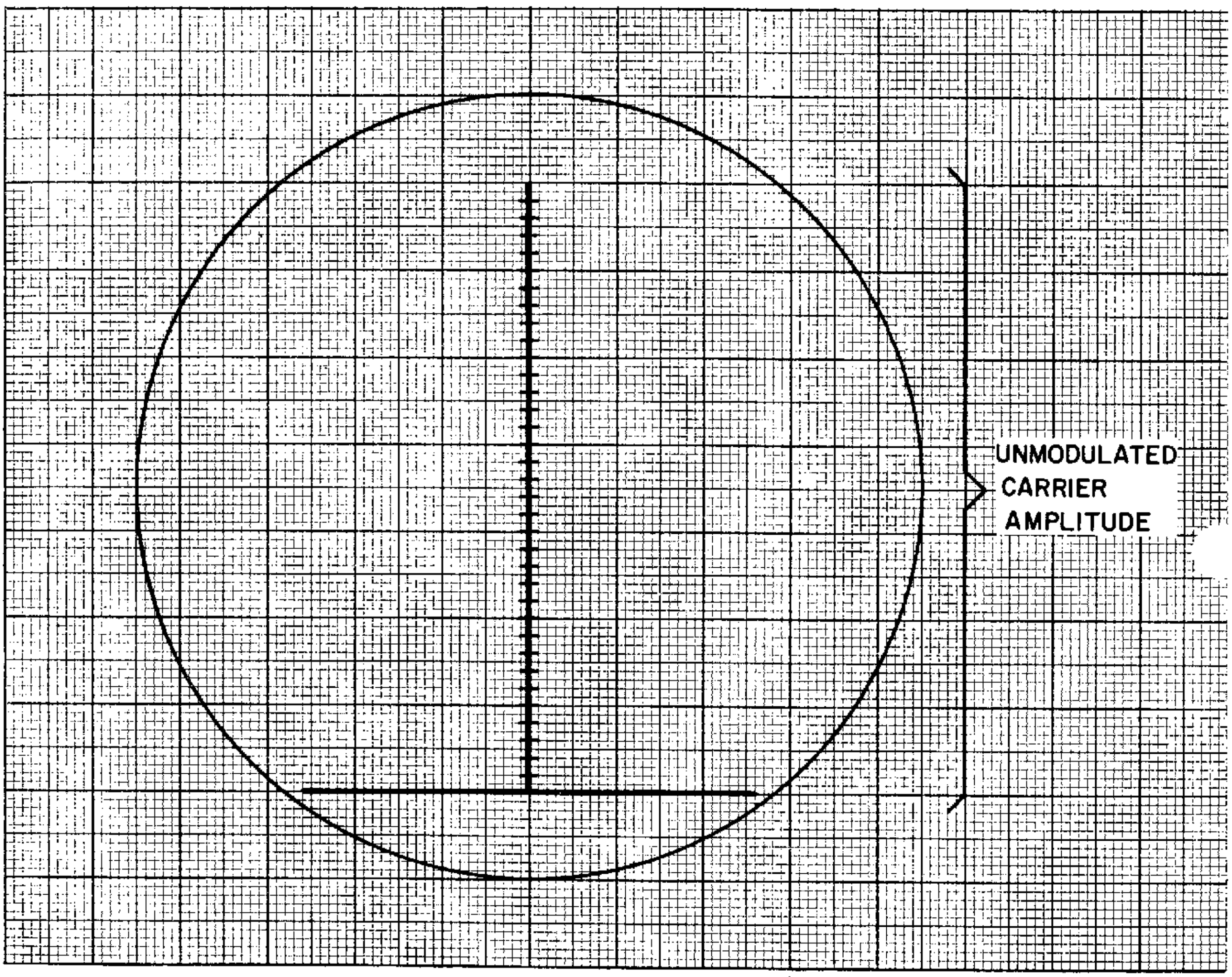


Figure C-2. Carrier With No Modulation

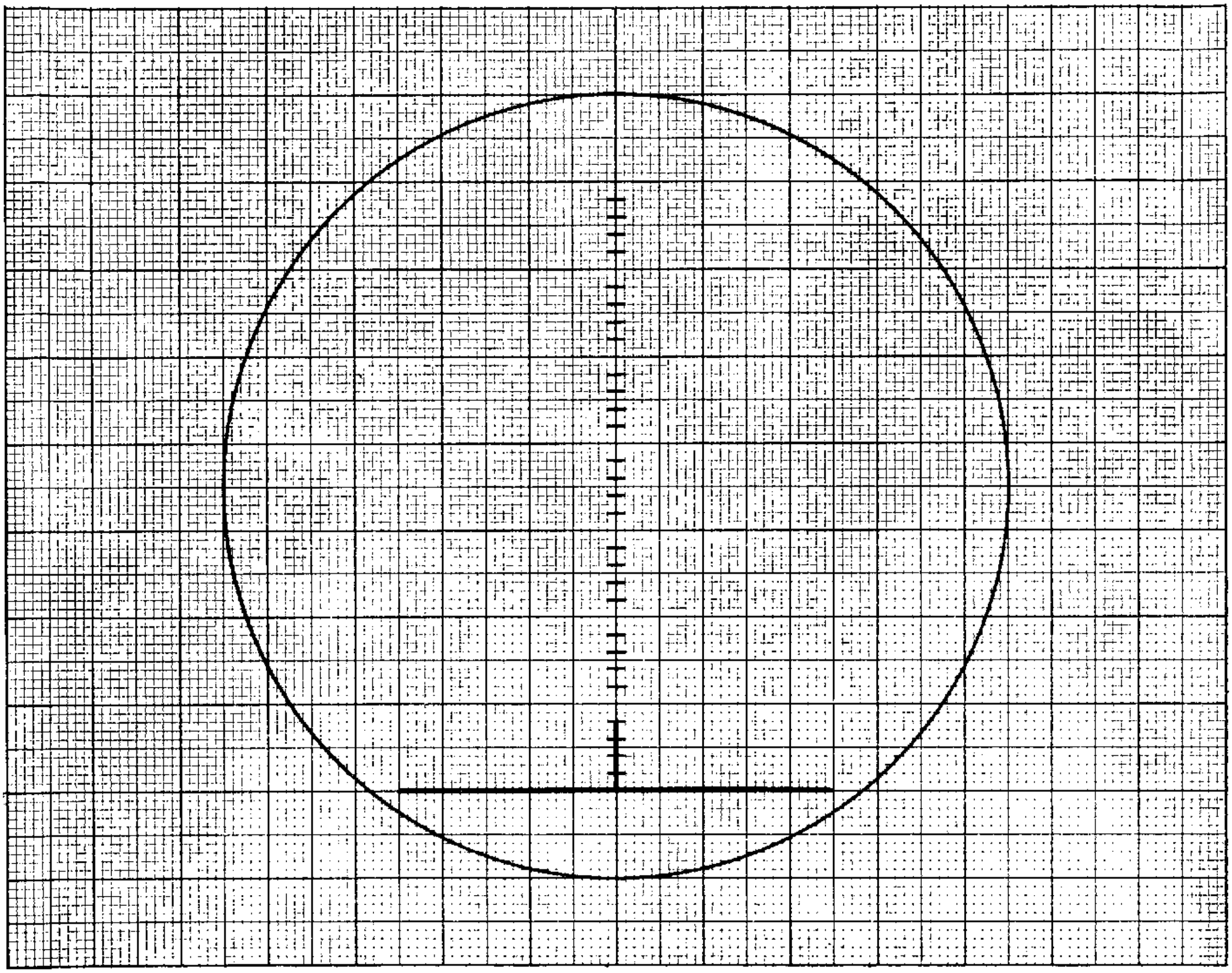


Figure C-3. Unmodulated Carrier Attenuated 16.6 dB

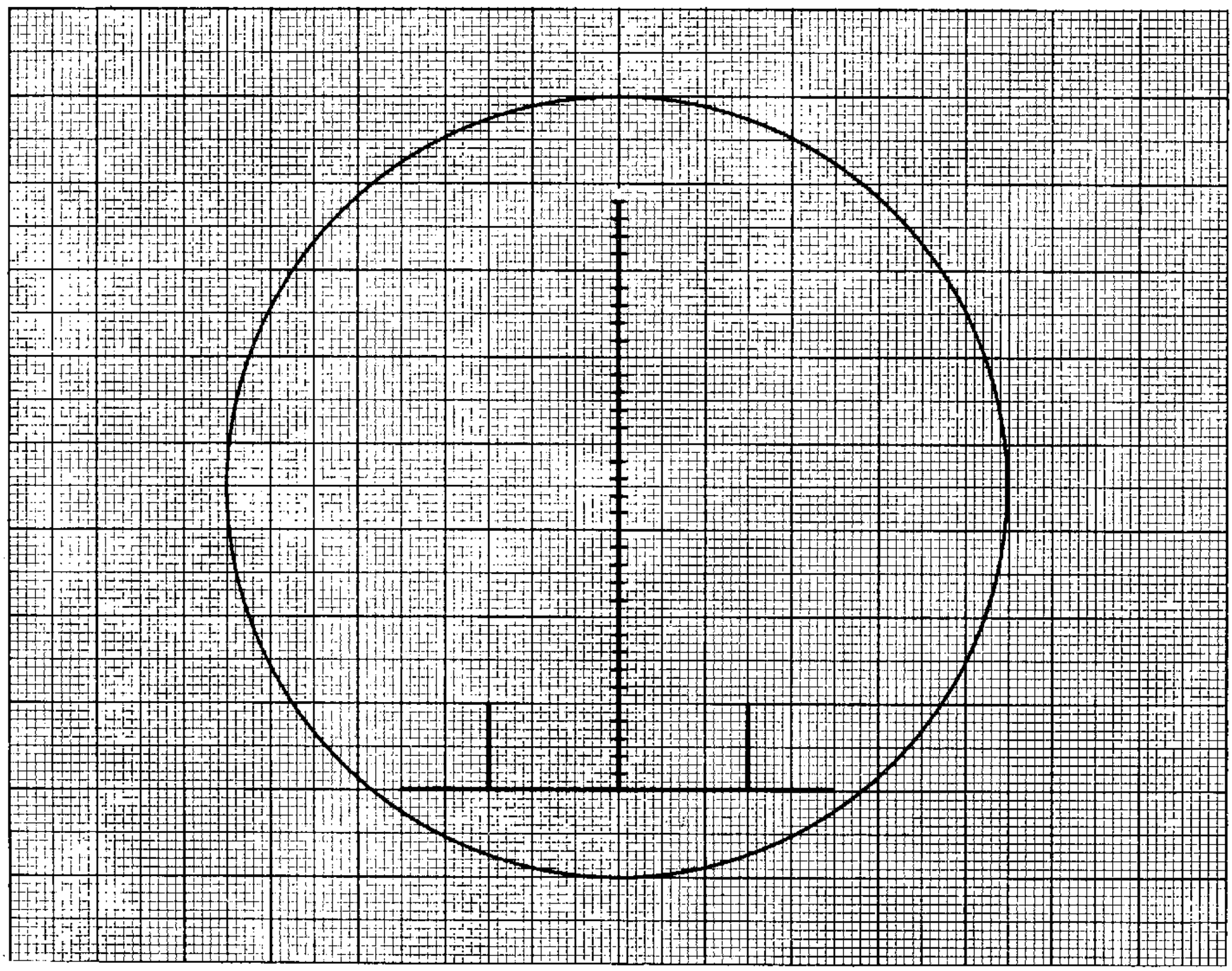


Figure C-4. Carrier With 768 kHz Subcarrier

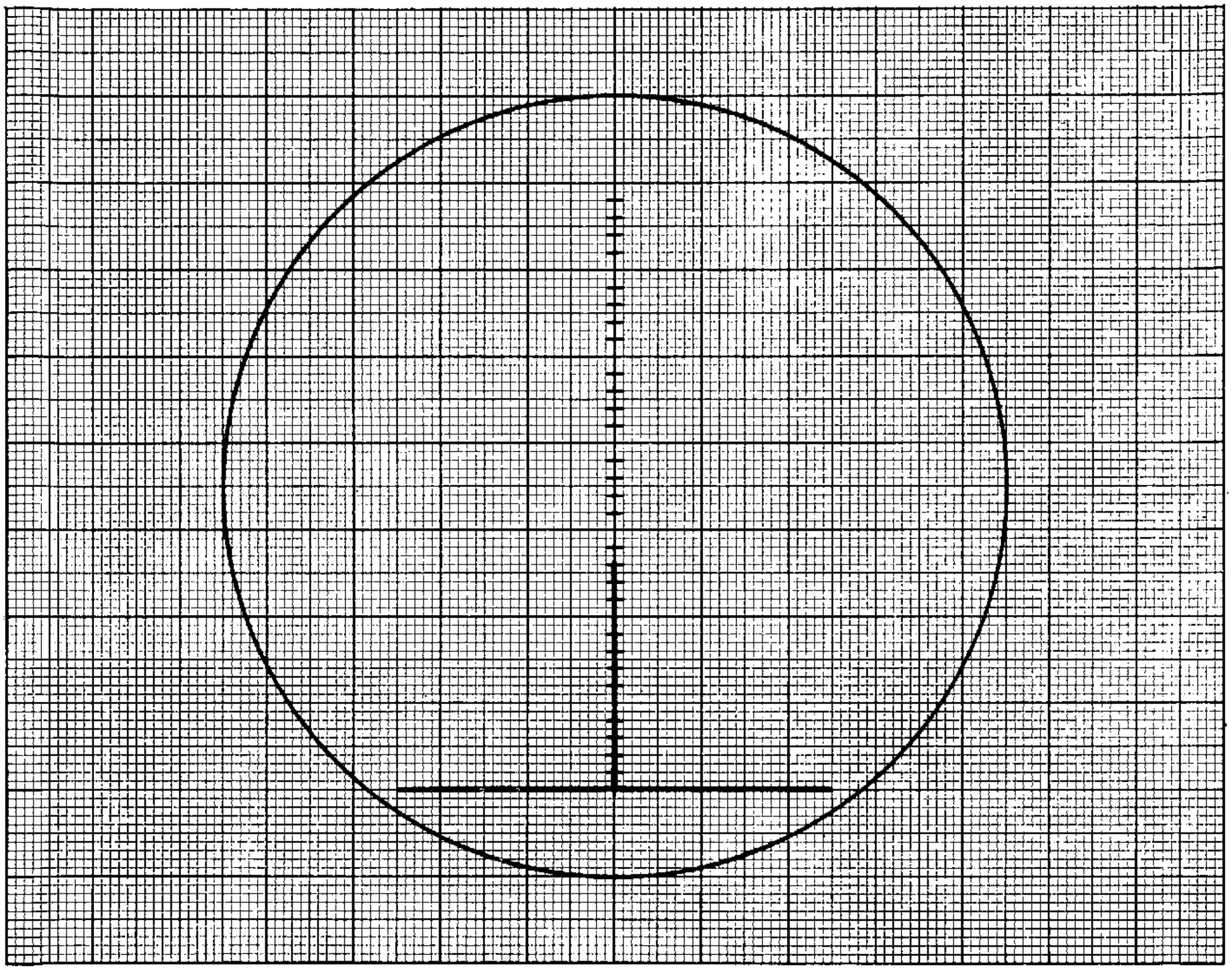


Figure C-5. Unmodulated Carrier Attenuated 8.6 dB

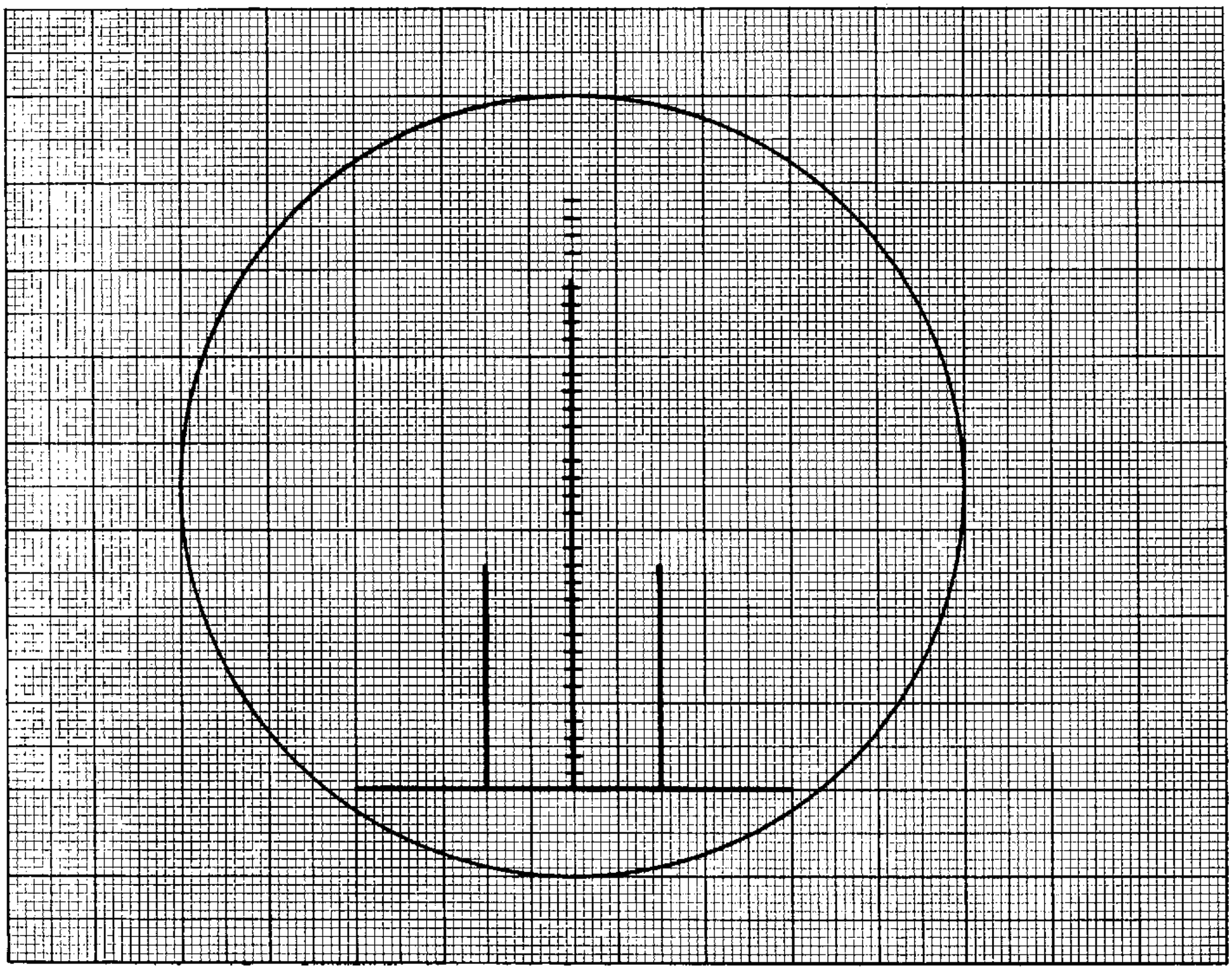


Figure C-6. Carrier With 597 kHz Subcarrier

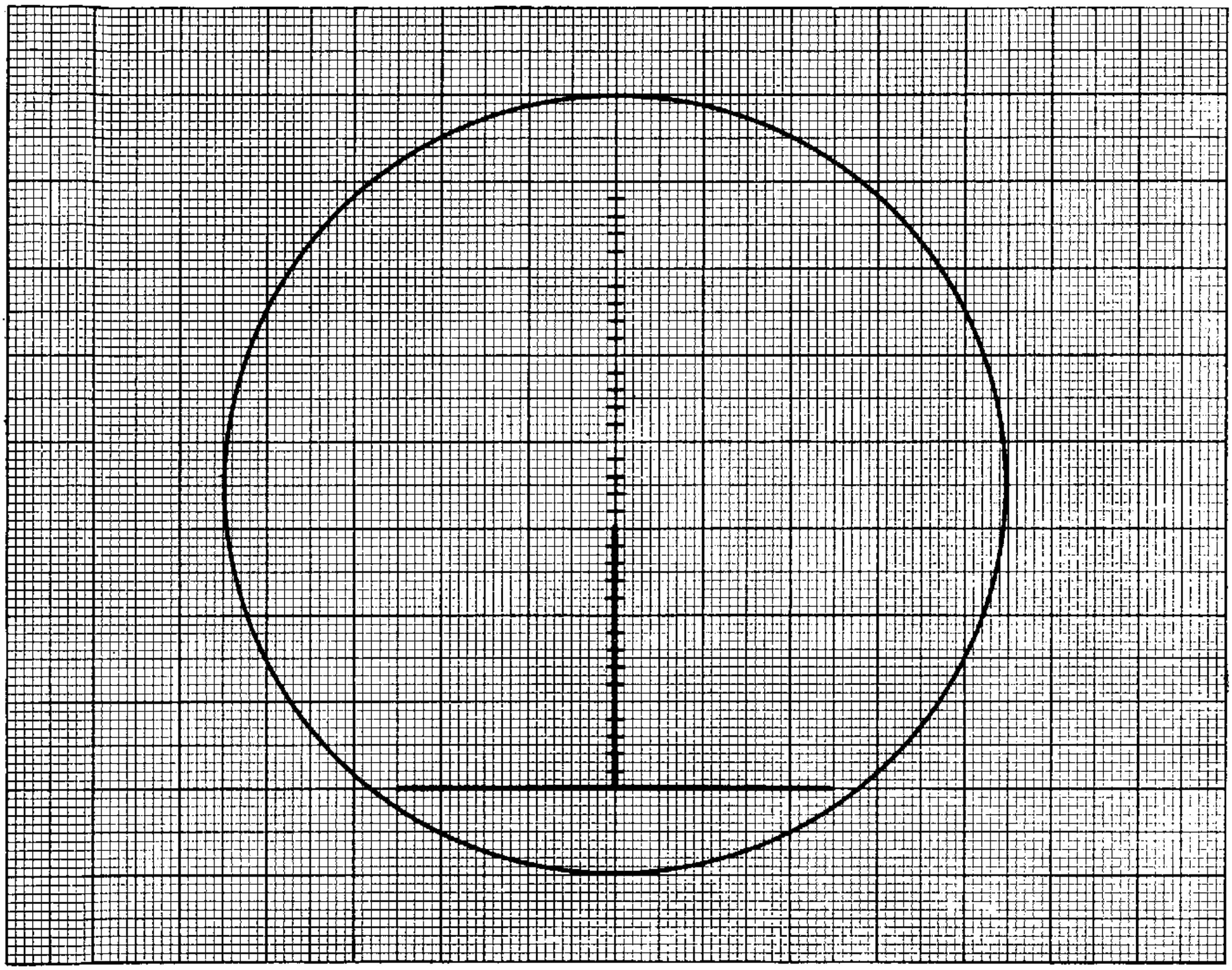


Figure C-7. Unmodulated Carrier Attenuated 7.2 dB

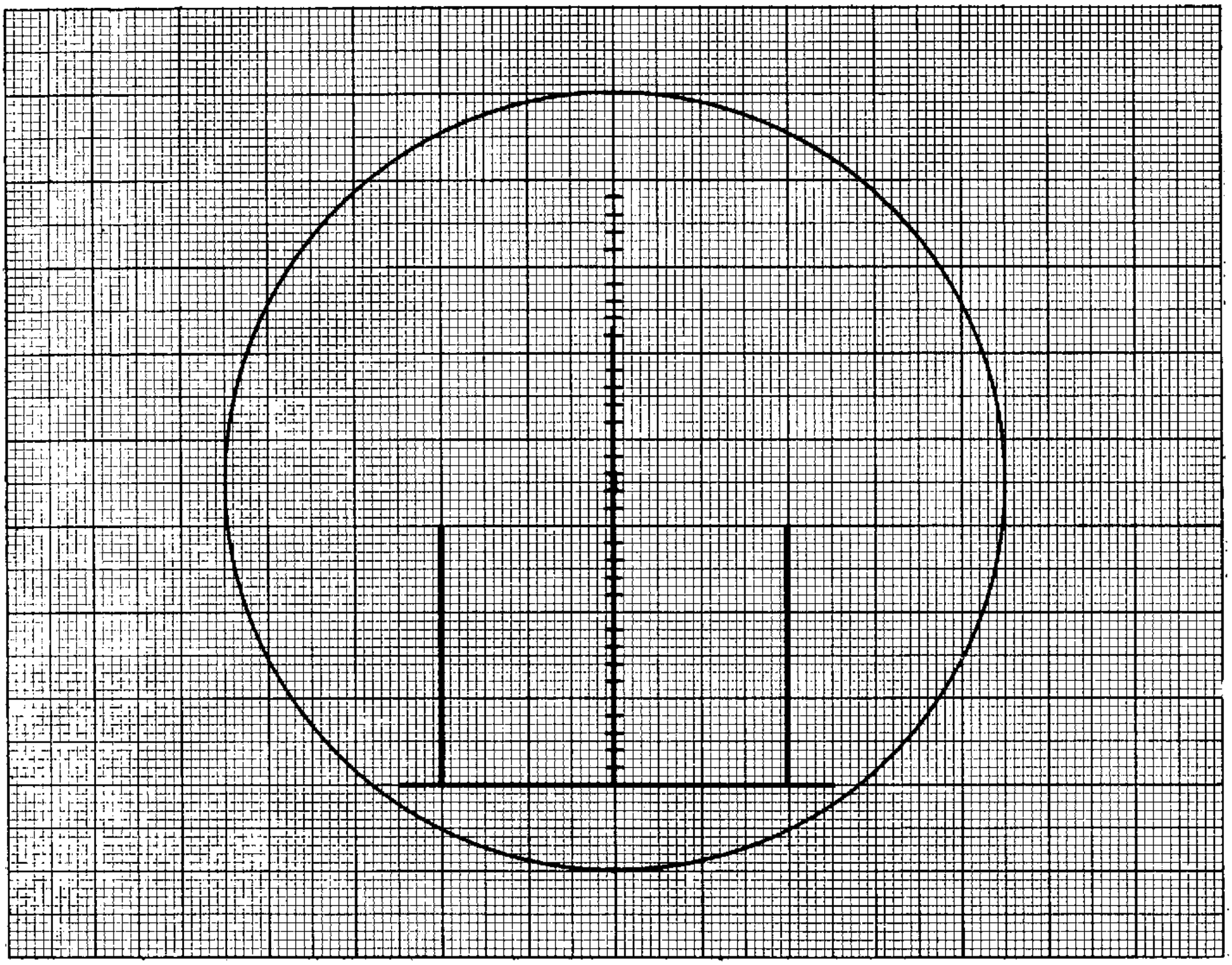


Figure C-8. Carrier With 1.024 MHz Subcarrier

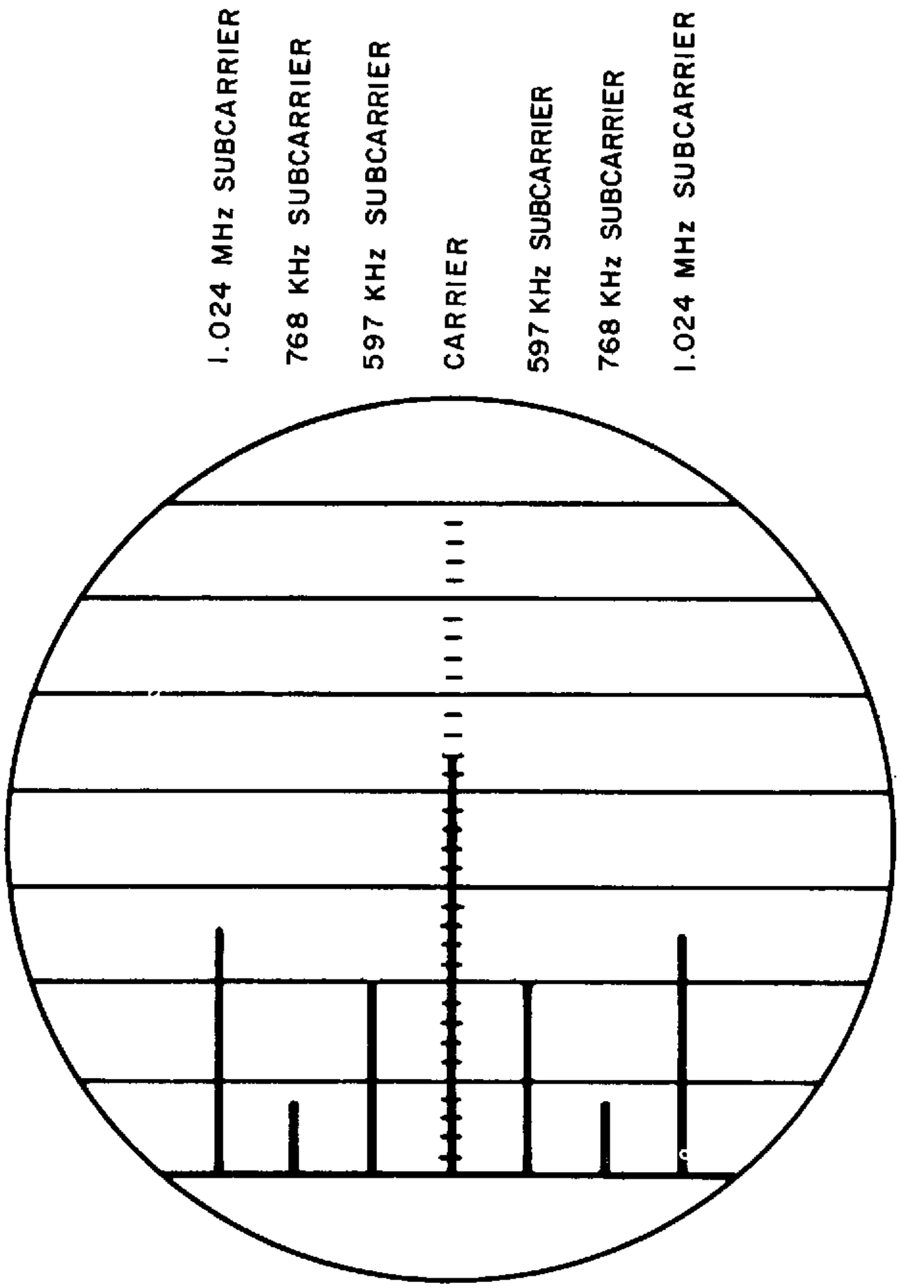


Figure C-9. Composite Spectrum

APPENDIX D

PCM/PSK TEST SETUP

1. PCM/PSK SWITCH SETTINGS AND TEST CONFIGURATION

Simulator Switch	Position
FORMAT	LOCAL
BIT RATE	VARIABLE
BIT RATE DEVIATION	0%
CLOCK/STORED	INT
MULTIPLIER	As required
BIT RATE SELECTOR	As required
FORMAT SELECTION	As required
BLANKING	OFF
OUTPUT SOURCE	STORED PROGRAM
CODE TYPE	SPLIT PHASE
OUTPUT RISE TIME	OFF
OUTPUT FUNCTION	SIGNAL
POLARITY	POS
COUPLING	DC
OUTPUT AMPLITUDE P-P	±6 V
Bit Comparator Switch	**Position**
MODE	WIDEBAND
DECOM	As required
DELAY	As required

PSK Simulator SW	Position
SUBCARRIER FREQUENCY	
CHNL No. 1	597 kHz
CHNL No. 2	768 kHz
CHNL No. 3 *	1.024 MHz *
NORMAL/INVERT	NORMAL
FILTER	IN
INTL SC/EXT SC	INTL
DATA MODE SOURCE	EXT PCM
DATA CODE	NOT USED
MIXER-PSK CHNLS	Selected Chnls ON
MIXER-EXT CHNLS **	Selected Chnls ON **
DATA FILTER BW	3X Bit Rate

Atec Counter

FUNCTION	RATIO A/B
MULTIPLIER	10^6
SAMPLING RATE	Fully clockwise
SLOPE	NEG

*USB Backup sites only

**ERTS Prime sites only

2. TEST CONFIGURATION

2.1 Patch the Atec counter as indicated in figure D-1.

2.2 Perform the following steps to check the Atec counter:

a. Set input controls for proper trigger on channel A and channel B. Trigger level may change with telemetry bit rate and with TIME BASE PERIOD MULTIPLIER switch setting.

b. Set the Atec multiplier switch to 10^5.

c. With the simulator POLARITY switch set to NEG and the signal conditioner POLARITY switch set to POS, the Atec counter should display 100,000 ±1 error.

d. With the simulator POLARITY switch set to POS and the signal conditioner POLARITY switch set to POS, the Atec counter should display 000,000 ±1 error.

e. Reset the Atec multiplier switch to 10^6.

f. Verify that the simulator POLARITY switch is set to POS.

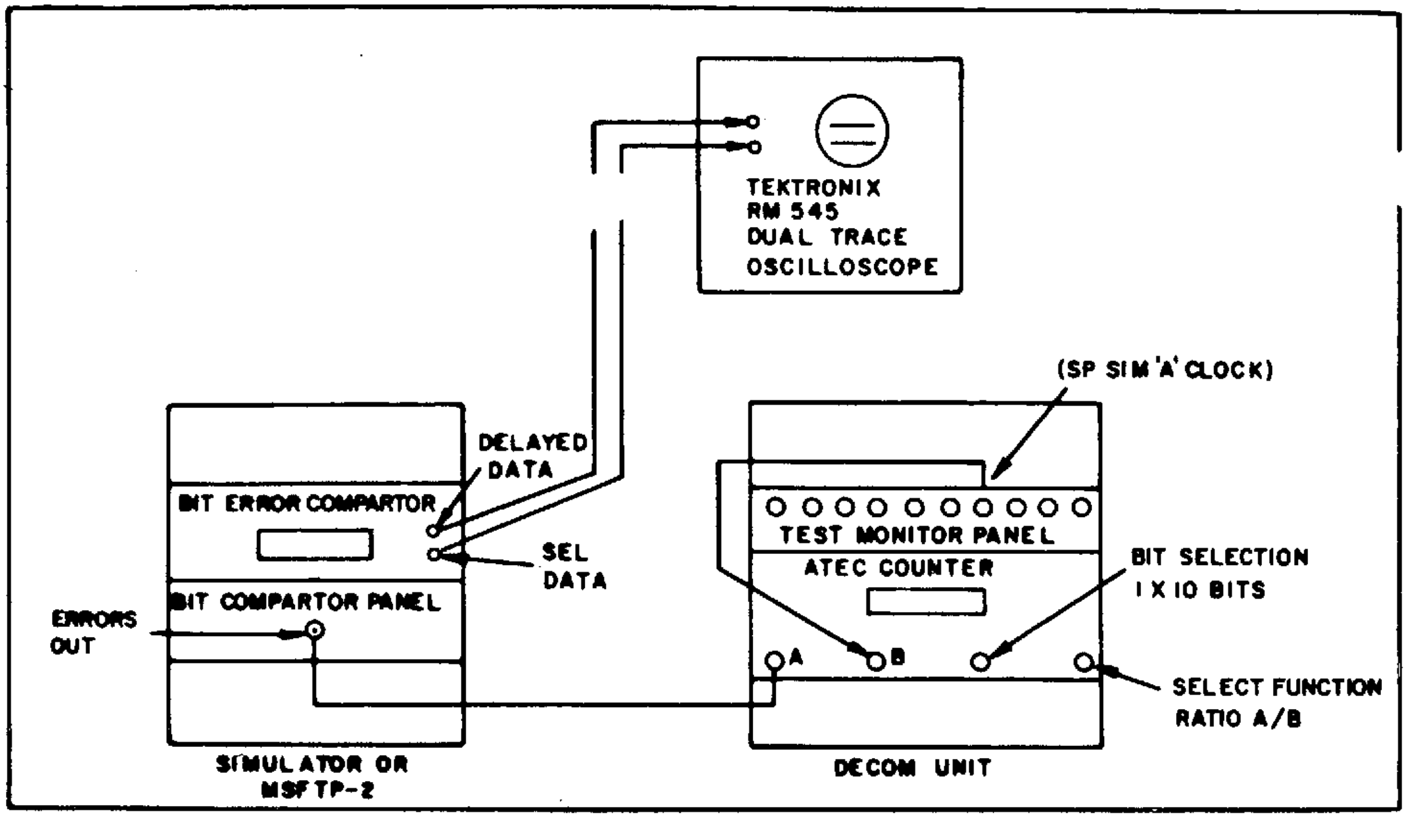


Figure D-1. Atec Counter Setup